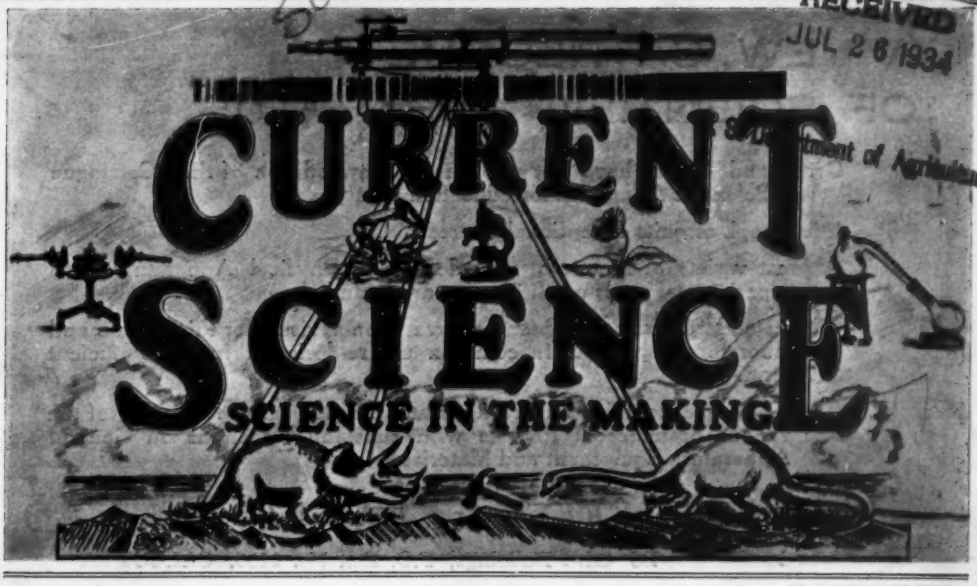

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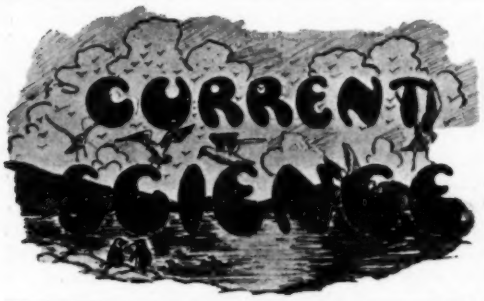

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CONTENTS.

An Indian Society of Soil Science.

THE past few years have witnessed considerable amount of interest in the different branches of Agriculture and especially in Soil Science, which has attracted a number of workers in different parts of India. This is to no small extent due to the keen interest and active support of the Imperial Council of Agricultural Research, who, by their generous grants, have greatly encouraged researches in that and kindred subjects.

At the suggestion of the Imperial Council, a joint meeting of the sections of Agriculture, Chemistry and Botany of the Indian Science Congress held at Bombay on the 15th January 1934 considered a proposal to organise a National Section of the International Society of Soil Science. The meeting approved of the proposal in general terms and appointed a Committee 'to consider the subject in all its aspects and formulate definite proposals regarding the foundation of the same'. The proposals of the Committee as also a draft Memorandum of the Association were considered by the Soil Science Committee of the Imperial Council who passed the following resolution which was subsequently approved by the Advisory Board of that Council—'The Committee endorse the view that the Indian Society of Soil Science should be essentially an unofficial organisation. The draft scheme and by-laws seem to them to be generally appropriate and they commend them to the careful consideration of all soil workers in India.' The provisional Executive Committee have now sent out circulars inviting workers in Soil Science to join the new Society and to offer their comments regarding the draft Memorandum of Association.

It is needless to emphasise that in an essentially agricultural country like India, a Society of Soil Science will be a highly useful organisation that can render excellent service to the cause of agriculture in the country. The subcontinent of India is big enough and the number of workers sufficiently large to justify the creation of not only an All-India Society but also a number of provincial sections devoted to the advancement of the cause of Soil Science. It is rather difficult, therefore, to understand why the special Committee should have proposed the affiliation of the new Society as a branch of the International Society of

Soil Science. It is admitted that the Indian Society should work in close co-operation with kindred societies in Europe and America but why should every member of the former also become a subscriber to the International organisation?

The *International* Society of Soil Science has a useful name with a large measure of popular appeal, but one might well enquire what it has so far done in the East and what the members resident in India can hope to gain by association with it? India has not so far had any representation on the Executive or any one of the numerous Committees or Commissions which that Society has appointed in recent years. It is needless to add that India has not been included in any of their surveys. It is true that all members in different parts of the world are welcome to their periodical meetings and to take part in discussions, but where—Copenhagen, Moscow or New Jersey! One might make a similar observation about the meetings of other learned Societies in Europe or America but there is at least the compensation of good Journals containing a number of original articles. The International Society of Soil Science publishes a *Proceedings* which contains mostly titles (in English, French and German) together with a few abstracts of papers published elsewhere. This compilation is not quite complete: nor is it up-to-date. It does not appear regularly or, at any rate, is not received regularly in India. The Society publishes a quarterly Journal, *Soil Research* which contains a few original articles, but its appearance is also irregular. As for the big congresses which are now being held once in five years, members as well as non-members have to pay the fees. The bulky volumes which represent the proceedings of those meetings are naturally expensive and have to be bought separately. Taking all together, one might well question why it should be made obligatory on the part of the members of the proposed Indian Society to subscribe for the International Society as well. The necessary International Association can be secured by the Indian Society being on terms of exchange with the sister organisation. Such articles as may interest workers in India may be copied or abstracted (with permission) and circulated among the members of the Indian Society. It is not necessary that the Indian Society should undertake to collect subscriptions on behalf of the International organisation or act as transmitting agency for Journals which are normally sent post-free to all subscribers. As for abstracts of publications in Soil Science, excellent service is now being rendered by the Imperial Bureau which is attached to the Rothamsted Experimental Station in England. In addition to fairly prompt publication of abstracts, that Bureau also publishes a number of special bulletins dealing with certain important aspects of Soil Science. The publications of that Bureau are already being received free by a number of research stations in India, so all that is now needed is merely an extension of that service to include the members of the new Society of Soil Science. A satisfactory arrangement would be for the Indian Society to offer to meet the cost of extra printing (or lithographing) and postage so that the Imperial Bureau may post them direct to the individual members.

Perhaps the most important function and at the same time the most difficult task of the new Society will be the organisation of co-operative research in Soil Science. Co-operation in scientific research and that especially in Soil Science is sadly wanting in India with the consequence that there is much duplication of work. Similar and, sometimes even the same problems, are being investigated at different research stations without the workers concerned being able to compare notes with each other. Promotion of co-operative research and that by a non-official organisation, though highly desirable, will be, by no means, an easy task. During recent years, several learned Societies have been started in India and abroad with the object of promoting co-operation among scientific workers but very few of them have succeeded in achieving their end. The failure is not, however, due to the fault of the Societies concerned. The ultimate reason lies in human nature itself, in the desire of the individual scientific worker to do everything by himself and not share credit with others. The tendency is there in almost every one and it is no use quarrelling with it. Even if a few laboratories undertake to conduct co-operative research, it would be very difficult to ensure useful results unless the workers concerned have opportunities to meet each other and discuss their findings. The proposed annual meetings would hardly provide the occasion for such discussions: they would come off during a very busy season when a number of other Societies also hold their annual meetings so that the members will have

practically no time for detailed discussion of specific problems. Special meetings among the interested members is almost out of the question, because India is a country of long distances and slow travel and it would be not only inconvenient but also highly expensive for individual members to attend such meetings.

The new Society would be rendering a very valuable service leading to the elimination of duplication and even facilitating co-operative research if they could arrange to publish periodical (preferably monthly) bulletins giving brief accounts of researches in progress at different experimental stations and the more important results obtained. This could be carried out with the assistance of a number of correspondents, one for each research station in India, Burma and, if possible, Ceylon. The correspondents will send their periodical notes to the Secretary of the Society who will rearrange the matter under different heads with the assistance of a publication committee. The bulletins may also include short reviews of researches spread over long periods or special articles dealing with subjects of general interest.

A publication of the above type will be welcomed by workers all over the country. It will not compete with any of the existing journals but will only supply a long-felt want. It will enable the workers to know what their colleagues are doing and what progress they have made in their researches. The rapid progress made by some workers may be a source of stimulus to their less active colleagues. In many cases, the information provided may be useful in avoiding duplication at other centres. The publication of short notes may also lead to workers engaged in the same or allied lines corresponding with each other and getting further particulars relating to the researches in which they are interested.

As things stand at present, only a small portion of the work done in the country gets to be known through the medium of specialist Journals. The major part gets 'lost' among the numerous provincial reports or bulletins which are not generally known to workers in other provinces, let alone the rest of the World. It is needless to add therefore that the workers will welcome a medium of publication which will ensure better recognition of their efforts.

It would greatly facilitate the work of the publication committee if the correspondents are given the necessary directions with regard to the preparation of their notes—the main heads under which the matter is to be arranged, the space to be allotted to each and so forth. It may also be desirable to offer small honoraria to correspondents for their efforts.

There are also other lines of activity such as preparation of annual reviews of researches in different lines and standardisation of laboratory methods and field technique wherein much useful work could be done. These activities may partly encroach on those of the Imperial Council of Agricultural Research or the Society of Biological Chemists (India), but there is still much specialised work which the Society would be best fitted to take up. The Society can also arrange for public meetings and technical symposia at different centres the proceedings of which can be included in the periodical publications. It would be premature for the Society to undertake the publication of a specialist journal devoted to Soil Science, but it may nevertheless be a useful objective to work for. The volume of research in Soil Science in the country is fast increasing and it may be reasonably expected that there would soon be sufficient material to maintain at least a quarterly journal.

It is perhaps unnecessary to add that the success of the Society, especially in the early years, depends, to a large extent, on the activities of the executive, particularly that of the secretary, whose hands should be strengthened as far as possible. The office as well as the funds should be placed unstintingly at the disposal of the secretary, who, it is hoped, will also have the facilities of a laboratory devoted to Soil Science and a well-equipped library. From this point of view, the proposal of the provisional committee to request the treasurer of another society to collect funds seems to be not only unnecessary but also undesirable. A proper arrangement will be for the secretary himself to act as the treasurer and organise the collection of funds on behalf of the Society. The subject of headquarters has lately become a thorny question in other directions, but it may nevertheless be useful to point out that a society devoted to the study of soils is best attached to a leading research station specialising in the subject—as is the case in other parts of the World.

It is very doubtful if the funds of the Society, especially in the early stages, will

permit of various types of useful activities being undertaken. It should at the same time be pointed out that the future success of the Society will, to a large extent, depend on its making a good beginning and achieving something tangible within the first few years. It is hoped therefore that the Imperial and the Provincial Governments, the Imperial Council of Agricultural Research, the different public bodies and the leading citizens of the country will come forward and assist the Society, in its laudable efforts, with generous grants and liberal donations.

V. S.

The Saline Series of North-Western India.*

By E. R. Gee,

Geological Survey of India, Calcutta.

THE Saline series of north-western India occurs within the Salt Range of the Punjab and in the adjoining district of Kohat in the North-West Frontier Province. In the Salt Range, between the Jhelum and Indus Rivers, it is overlain by Cambrian (possibly pre-Cambrian) strata in the east and mainly by the Talchir Boulder-bed (probably Upper Carboniferous) in the west, though in the vicinity of the Indus near Kalabagh (32° 58′ : 71° 33′), Siwalik strata immediately succeed it. About 17 miles north of Kalabagh, salt-bearing marl and gypsum again crop out along the axes of fold-faulted anticlines over a wide area within the Kohat district. Here it is overlain by sediments of Upper Nummulitic (Middle Eocene) age. Between these two main exposures, about 8 miles north of Kalabagh, two small inliers of the marl with rocksalt occur along the faulted axis of an anticline composed of sandstones and clays of Lower Siwalik (Chinji) and Middle Siwalik age.

The original geological surveys of these areas were carried out by A. B. Wynne of the Geological Survey of India in the 'seventies. The influence of large tectonic thrusts being at that time largely unrecognised, Wynne was very naturally led to conclude that the salt and associated deposits of the two areas were of different geological ages, those of the Salt Range being early Palæozoic (or pre-Cambrian), whilst the salt-bearing marl of Kohat was regarded as of Eocene age.

Since the time of these original surveys, numerous visits have been paid to these areas by geologists and a voluminous literature has accumulated regarding these interesting deposits, at least five different theories having been evolved to explain their age and origin. It should be mentioned, however, that although these theories were often based on the examination of a number of isolated sections within the areas in question, time did not permit the inspection of the whole tract by any one observer. As a result, certain critical sections appear to have been overlooked. In the writer's opinion, there is no doubt that had the evidence of these critical sections been adduced, the 'salt marl' controversy would have been settled long since and the publication of certain of the theoretical opinions would have been spared.

During the past six field-seasons, the Salt Range has been geologically surveyed by the writer and mapping has been continued northwards to link up with the Kohat salt region. In the course of this survey, evidence has come to light that appears to prove conclusively that the Saline series of the two areas are homotaxial and of Eocene (probably Middle-Lower Eocene) age.

In the eastern part of the Salt Range, the greatest development of the Saline series is exposed. It includes an upper stage of massive gypsum with flaggy dolomite and some bituminous shales, varying up to about 200 feet thick, a middle stage of red marl with thick seams of rocksalt, attaining a thickness of at least 600 feet, and a lower stage of marl, gypsum, bituminous shales, and dolomite also several hundred feet thick; the base of the series is not seen. In the Kohat salt region, exposures are mainly of the upper and middle stages.

Evidence regarding the age of the Punjab Saline series is obtained from certain sections in the western end of the Cis-Indus Salt Range. Here, the foraminiferal Eocene limestones (probably Laki), at the top of the Nummulitic Limestone sequence of the

* Published with the permission of the Director, Geological Survey of India.

northern dip-slopes of the range, pass laterally into the massive, white and grey gypsum stage that caps the Saline series. The section, 4 miles east of Daud Khel (32° 53′ : 71° 34′), is extremely clear, the lateral passage from the grey and white limestones into dark, foetid-smelling limestones with subordinate gypsum and the more rapid passage of the latter into massive gypsum (about 300 feet thick) takes place within a few hundred yards. Above the limestones and the gypsum, the Lower Siwalik beds continue regularly, whilst below the limestone-gypsum stage, the light grey shales and limestones and underlying thick nodular limestone of the middle and lower portions of the Nummulitic sequence are observed to crop out with equal regularity. About three-quarters of a mile north-west of the end of these exposures, the massive gypsum is underlain by typical red marl with rocksalt, this apparently taking the place of the light grey shales and limestones of the middle portion of the Nummulitic sequence. The basal nodular foraminiferal limestones are found adjacent to the gypsum and salt marl and underlying it. That this salt-bearing marl and gypsum is the continuation of the main Saline series of the Salt Range is clearly indicated not only by the similarity of the sequence but also by the fact that in the latter outcrop it is associated with the Talchir Boulder-bed in the same manner as occurs in the adjoining scarp slopes of the western half of the Salt Range.

Agreement with the above correlation is expressed by Dr. A. M. Heron, Geological Survey of India, who has recently examined these and other sections in the Punjab Salt Range. An Eocene age is also advocated by P. Evans, Burmah Oil Co., Ltd., who has recently surveyed these critical sections in detail and has examined other portions of the range.

In the Kohat salt region, the equivalence of the Laki Limestone (Middle Eocene) and at least a large portion of the massive gypsum stage at the top of the Saline series of that area had been proved fairly conclusively on stratigraphical and palæontological grounds by D. N. Wadia and L. M. Davies (see *Trans. Min. & Geol. Inst. Ind.*, **XXIV**, pp. 202–222, 1929) and these observers were strongly inclined to regard the underlying salt-bearing marl as of Lower Eocene age. E. S. Pinfold also advocates a Nummulitic age for the Kohat salt. He has arrived at this correlation on stratigraphical grounds by comparing the Kohat sequence with that of the Chharat area of the Attock district, Punjab. More recently, fossil fish of post-Cretaceous type (identified by Dr. E. I. White) were discovered by the writer within the gypsum stage at the top of the Saline series near Malgin (33° 19′ 30″ : 71° 31′ 30″), Kohat district. This fossil evidence at least does not conflict with the above-mentioned conclusions regarding the age of the series.

It is interesting to note, therefore, that the conclusions relating to the age of the Saline series of the more complicated and controversial Salt Range area, as deduced from the stratigraphical evidence afforded *within that area alone*, agree closely with those arrived at regarding the similar deposits of the adjoining Kohat tract; namely, that the topmost gypsum and underlying salt-bearing marl stages are of Nummulitic (probably Laki) age.

It is therefore concluded that the Saline series—Upper Nummulitic sequence of the Kohat region is, on the whole, a normal one unaffected by any widespread unconformities or planes of thrusting within it. In the Salt Range, the circumstances are different and a very regular thrust of immense dimensions must be postulated in order to explain the present position of the Saline series beneath the early Palæozoics (or pre-Cambrian) and the Talchir beds. The writer is of the opinion that this overthrust was formed gradually in post-Nummulitic—pre-Siwalik times (movement may have commenced towards the end of the Nummulitic) during the period represented by the important unconformity that underlies the Murree-Siwalik strata of the Salt Range and Trans-Indus Ranges. He concludes that the forces that brought about this immense overthrust during the uppermost Eocene and Oligocene period mark the inauguration of earth-movements which, directed from the north (in the Salt Range area) and from the west (in the Trans-Indus area) finally gave rise during a second period of more complicated folding and thrusting (in late Siwalik to sub-Recent times) to the orogenic belts of the north-western Himalayas, the Hindu Kush and the Sulaiman ranges.

The *nappe* involved in the primary overthrust extended from the Salt Range and Trans-Indus Range sequence (above the Saline series) in the south, through what are now the Potwar, Kohat and Bannu areas, to link up with the stratigraphy of the above-mentioned mountainous regions

to the north and west. At the time of the inauguration of this immense primary thrust at the end of the Nummulitic period, north-western India was, therefore, capped by a thick Nummulitic sequence consisting in places of limestone, shale and sandstone strata, in others of the Saline series sedimentaries including beds of massive gypsum at the top. Two of the principal areas in which the saline facies prevailed were the tract now occupied by the Salt Range (and for some considerable distance to the north and south) and that now represented by the Kohat Salt region. It is quite possible that these two areas of Saline deposition were linked up *via* what is now the Kalabagh-Shakardarra (33° 14′: 71° 30′) tract. As the intensity of the forces from the north and west increased, it is concluded that a very regular overfold, passing later into a definite equally regular overthrust, was formed along the northern and western boundaries of the Salt Range saliferous tract. The massive gypsum capping the salt-bearing marl doubtless formed a very suitable lubricating medium above which the *nappe*, consisting of Palæozoic (including the Purple Sandstone series), Mesozoic and Nummulitic (including the Saline series of Kohat) rocks, slid with ease whilst the absence of any *massif* for some considerable distance to the south afforded equally favourable circumstances for overthrusting on a large scale. Overriding across the Saline series of the Salt Range area, up to a distance of *at least* 20 miles towards the south (as indicated by inliers of the Saline series at Vasnal and Kallar Kahar on the Salt Range plateau), therefore took place during this post-Nummulitic—pre-Siwalik interval resulting in the relative uplift of the *nappe* in the area in the vicinity of what are now the Salt Range and Trans-Indus Ranges. Concurrently, a geosynclinal tract was formed in the Potwar to the north and the Kohat and Bannu areas to the north-west and west.

A period of relative quiescence then followed in mid-Tertiary and early upper Tertiary times during which the Murree and Siwalik sediments were laid down in this geosyncline. During a considerable part of this period, the relatively elevated Salt Range and the Trans-Indus Ranges were eroded to a greater or less extent, the amount of erosion increasing in both areas to the rise, that is, towards the south in the former area and towards the east in the latter. In the more elevated tracts, denudation continued in places well into Siwalik times exposing a land-surface composed of Palæozoic and Mesozoic rocks of the primary *nappe*. Upon this eroded land-surface, the Middle Siwaliks transgressed. During this period of erosion and subsequent Siwalik deposition, the salt marl and associated deposits of the Salt Range were of course protected by the strata comprising the primary *nappe*.

In late Siwalik to sub-Recent times, a second period of acute earth-movement prevailed, the forces coming from the same northerly and westerly directions. However, owing to the fact that by the end of the primary movements the *nappe* had been brought southwards and eastwards to the vicinity of an Archæan *massif*, remnants of which exist in the Kirana hills about 40 miles south of the Salt Range, appreciable further sliding in these directions was impeded. Therefore, with the increase of the orogenic forces, the acute folding and shearing of the strata forming portions of the Potwar-Kohat-Bannu geosyncline took place and similar folding and duplication by thrusting occurred near the outer edges of the primary *nappe* in the Salt Range and Trans-Indus Ranges. At the time of this second phase of acute earth-movement, however, the Nummulitic Saline series of the Salt Range area was underlying the older beds of the *nappe* and naturally acted in close association with these overlying Palæozoic strata, being folded and sheared along with them as though it were a portion of a normal stratigraphical sequence. This explains the intimate relationship of the Saline series and the Palæozoic rocks throughout the greater length of the Salt Range.

Striking evidence of the very recent age of certain of these acute earth-movements is afforded not only by the steeply-dipping post-Siwalik sands, clays and conglomerates of the Salt Range plateau, but also by the occurrence of relatively very recent beds intercalated within the gypseous marl stage near the base of the scarp in the eastern part of the Cis-Indus Range. Here, in close association with this gypseous marl, we find beds of red clay and soft sandstone, including boulders of gypsum, dolomite and Khewra trap (derived from the Saline series), Purple Sandstone and Magnesian Sandstone. The gypseous marl is often greatly disturbed (brecciated, sheared and foliated) and the associated more recent

deposits also show high dips in general conformity to those of the normal marl. These very recent deposits vary from thin lenticular inclusions, up to more regular sediments over 200 feet in thickness. It is concluded that these beds, derived by the erosion of the Salt Range scarp and deposited at the foot of the range, were caught up among the strata of the gypseous marl stage during the above-mentioned period of acute post-Tertiary earth-movement.

The occurrence of these beds and the similarity of some of them to beds of the Saline series makes it difficult to be sure of the value of any fossil evidence that may be found. Some of the deposits of this type contain derived foraminifera and it is possible that all the foraminiferal bands hitherto discovered are later than the Saline series. Plant fragments, however, have been found not only in beds of doubtful age but also in beds which are regarded as being definitely *in situ* in the Saline series; thus providing independent evidence that the Saline series is not Cambrian.

Regarding the question of structural evidence of the postulated primary thrust-plane, it has been observed by earlier writers that the overlying Purple Sandstone strata (Cambrian or pre-Cambrian) show signs of brecciation and slickensiding near their junction with the massive gypsum that forms the uppermost part of the Saline series. This disturbance appears to be on too large a scale to be explicable by the difference in competence of the beds above and below the junction. More definite evidence is provided by the beds beneath the junction, the gypsum bands being often found contorted and the hard cherty and dolomitic layers definitely brecciated.

Still more convincing is the evidence afforded by the Talchir Boulder-bed in the vicinity of its junction with the underlying gypsum. Throughout a distance of about 30 miles in the western part of the Salt Range, this conglomerate directly overlies the Saline series and there are numerous clear sections showing the junction of the two series. In these exposures, throughout a thickness varying up to about 20 feet above the junction, the stratification of the shale matrix has been obliterated and the majority of the included boulders, consisting of hard granites, gneisses, quartzites, rhyolites, etc., have been crushed and sheared, the sheared fragments being often held together by growths of secondary gypsum (selenite) brought up by capillarity from the underlying Saline series. In those sections in the eastern and middle parts of the Salt Range, where the boulder-bed rests on the early Palæozoic or pre-Cambrian strata, no evidence of such disturbance is observed.

In conclusion, it should be mentioned that the above-described opinion regarding an immense regular overthrust in pre-Siwalik times follows in many essentials the theory postulated by Sir Edwin Pascoe in his memoir entitled 'Petroleum in the Punjab and North-West Frontier Province' (*Mem. Geol. Surv. Ind.*, **XL**, Pt. 3, pp. 363-371, 1920). The idea of an overthrust of this type was previously held by Sir Thomas Holland and Drs. Koken and Noetling.

"Current Science" and "South Indian Science Association".

OUR attention has been drawn by one of our Editorial co-operators and one correspondent to the effect that Dr. S. Subba Rao, President, South Indian Science Association, in his opening address at the Easter Congress of Scientists at Bangalore, claimed *Current Science* as an organ of the South Indian Science Association. On referring the matter to him, Dr. Subba Rao has written to say that he made no such statement.

It is needless to emphasise that *Current Science* is an independent all-India Journal and stands for the progress of scientific work in India as a whole.—*Editor.*

Studies on the Pollen-Tubes.

II. The dependence between the potency of the pollen-tube growth in foreign styles and the thickness of the pollen-tubes and chromosome number.

By Dontcho Kostoff.

(At the pr. t. Institute of Genetics, Academy of Sciences of U.S.S.R., Leningrad, U.S.S.R.)

IN investigating the problem of the interspecific hybrids in *Nicotiana*, we stated that the following conditions are necessary for the successful production of the hybrids: (1) germination of the pollen of the paternal plant on the stigma of the maternal plant, (2) a necessary growth potency of the pollen-tubes in order to reach the ovary and penetrate into the micropyle of the ovule, (3) the occurrence of fertilization, (4) a satisfactory growth of the hybrid embryos, (5) germination of the seeds produced following hybridization, (6) surviving of the seedlings during the cotyledon stage and further development until maturity.

Previous investigations (Kostoff 1930, and Prokofieva 1934) showed that a definite dependence exists between the growth potency of the pollen-tubes and the length of the styles of the species from which the pollen originates. The longer the styles the plant has the greater growth-potency the pollen-tubes possess. The length of the styles of the maternal species plays an important rôle too. The shorter the styles are (the shorter the way between the stigma and the ovary) the sooner the pollen-tubes reach the ovary. When the styles of the maternal species are considerably longer than those of the paternal one, the pollen-tubes usually do not succeed to reach the ovary and the hybridization fails.

Further investigations show that this is not the single cause for the failure of the hybridization. The measurements of the pollen grains and the pollen-tubes we carried out lately show definitely that in many cases the nucleoplasmic ratio of the pollen and further of the pollen-tubes represents a regulating factor for the velocity of the pollen-tube growth too.

The data given in Table 1 show that species with larger chromosome numbers (given there) have larger pollen grains. The same dependence seems to exist between the number of the chromosomes and the thickness of the pollen-tubes as shown in Tables 2 and 3. This is true for the auto-tetraploid forms when compared with the diploid forms. It also seems to be true for the amphidiploids (tetraploids) in relation to their parents and for the very closely related species but obviously not for the far related species.

The pollen-tubes of the tetraploid tomato ($4n = 48$) do not reach the ovary of the diploid ones ($2n = 24$) while in the reverse cross, namely $2n \times 4n$, the pollen-tubes of

TABLE 1.

Species	Chromosomes ($2n$) in the soma	Diameter of the pollen grains in micrones										
		20	23	25·7	28·6	31·5	34·3	37·2	40	42·9	45·8	48·6
Nicotiana rustica ..	48	..	..	..	..	1	25	89	63	22	..	..
N. paniculata	24	..	1	17	39	105	28	3	..	..	..	..
N. rupa, i.e., an amphidiploid of *rustica* × *paniculata*	72	..	..	..	..	..	6	18	25	119	21	1
N. glauca	24	..	..	..	20	66	24	..	..	..	..	..
N. Langsdorffii ..	18	..	1	38	64	18	..	..	..	..	..	..
N. glauca × *Langsdorffii* amphidiploid ..	42	..	..	..	..	3	19	92	85	26	..	..
S. Lycopersicum (tomato) diploid ($2n$) ..	24	10	174	17	..	..	..	..	..	..	..	..
S. Lycopersicum— tetraploid ($4n$) ..	48	..	3	47	129	21	..	..	..	..	..	..

TABLE 2.

Species	The thickness of the pollen-tubes in microns															
	5·7	6·4	7·2	7·9	8·6	9·3	10	10·7	11·4	12·2	12·9	13·6	14·3	15·0	15·7	16·4
Nicotiana rupa ..	..	..	..	..	1	3	3	2	26	6	7	7	24	4	12	4
N. rustica ..	..	..	..	..	22	16	18	7	30	1	3	3	1	..	..	..
N. paniculata ..	2	3	8	14	50	16	7	1	2	..	..	..	..	..	..	..

TABLE 3.

Form	The thickness of the pollen-tubes in microns											
	47	52	57	62	67	72	77	82	87	92	97	Total number
Diploid tomato ..	1	81	62	15	3	1	..	..	..	..	..	163
Tetraploid tomato ..	..	..	..	1	..	42	48	31	37	18	3	180

$2n$-plants with n-chromosome number reach the ovaries of the $4n$-plants.

The pollen-tubes of *Nicotiana rupa*, an amphidiploid plant from the F_1 (*N. rustica*, $n = 24 \times$ *N. paniculata*, $n = 12$), reach the ovary of *Nicotiana rupa* and of *Nicotiana rustica*, but rarely of *N. paniculata*, while the pollen-tubes of *rustica* and *paniculata* reach easily the ovary of *N. rupa*.

The pollen-tubes of the amphidiploid plants of *N. glauca* (n=12) × *N. Langsdorffii* ($n = 9$) do not reach the ovary of *N. Langsdorffii*, while the pollen-tubes of *N. Langsdorffii* reach easily the ovary of the amphidiploid hybrid which has 42 somatic chromosomes. We must here point out that the length of the styles is in favour of the cross *N. Langsdorffii* × amphidiploid (*glauca* × *Langsdorffii*), though the pollen-tubes do not reach the ovary in this cross combination but in the reciprocal one. Consequently, the thickness of the pollen-tubes seems to be here also the responsible factor.

In order to be able to estimate correctly the importance of the chromosome number in the pollen-tube growth process following inter-specific crosses, the factor "length of the styles" must be eliminated. The investigations in *Triticum* inter-specific hybrids show that the crosses $4n \times 6n$ are more successful than the reciprocal $6n \times 4n$ (Literature, see in Katayama, 1933). There is not a definite rule in *Nicotiana* if we do not consider the length of the styles. Thus, for example, the pollen-tubes reach easier the ovary in the following cross combinations: *N. rustica* ($n = 24$) × *N. Tabacum* ($n = 24$), *N. rustica* × *N. paniculata* ($n = 12$), *N. Tabacum* × *N. sylvestris* (n=12), *N. Tabacum* × *N. glauca* ($n = 12$), *N. glauca* × *N. Langsdorffii* ($n = 9$), *N. paniculata* × *N. Tabacum*, *N. suaveolens* ($n = 16$) × *N. Tabacum*, *N. glutinosa* (n=12) × *N. Tabacum*, *N. Langsdorffii* × *N. longiflora* ($n = 10$), etc., than in the reciprocal crosses. If we judge these examples as they are without consideration of the other factors involved in the pollen-tube growth, we must conclude that there is not any dependence between the number of the chromosomes and the growth of the pollen-tubes. Such a conclusion is undoubtedly wrong. In order to have really an unquestionable criteria of the significance of the chromosome number in the parental species for the velocity of the pollen-tube growth we must unconditionably consider the length of the styles of the species crossed, and which plant is used as maternal one. In other words, the factor "length of the styles" must be eliminated, and then the study of the crossability of the species with various chromosome numbers in relation to the velocity of the pollen-tube growth can be possible. For such a study we must

take species that have approximately the same length of the styles, but different chromosome numbers.

The middle lengths of the styles of some *Nicotiana* species are given in Table 4. *N. Tabacum* var. *macrophylla* has a style of about 42 mm. *N. Sanderæ* of about 40 mm. The pollen-tubes of *N. Sanderæ* reach the ovary of *N. Tab. macrophylla*, while the pollen-tubes of *N. Tab. macrophylla* do not reach the ovary of *N. Sanderæ*. *N. Rusbyi* and *N. Tabacum* var. *sanguinea* have approximately the same length of the styles, though different chromosome numbers, and the pollen-tubes of *N. Rusbyi* reach the ovary of *N. Tabacum sanguinea*, while those of the latter do not reach the ovary of the former. *N. Langsdorffii* has even shorter style than *N. Rusbyi*, *N. paniculata*, *N. glauca*, *N. Tabacum* and *N. glutinosa*, but it has $n=9$, *i.e.*, less than any one of these species and its pollen-tubes reach the ovaries of all these species, while in the reverse crosses only the pollen-tubes of *glauca* may in exceptional cases reach the ovary of *N. Langsdorffii*. *Langsdorffii* pollen-tubes may sometimes reach even the ovary of *N. longiflora*, a species with the longest styles.

TABLE 4.

Species	Somatic chromosome number	Approximate length of the styles in mm.
N. longiflora[1]	20	ca. 85
N. Tabacum var. *macrophylla*	48	ca. 42
" " " *sanguinea*	48	ca. 34
N. Langsdorffii	18	ca. 17·5
N. glauca	24	ca. 25
N. paniculata	24	ca. 24
N. glutinosa	24	ca. 20
N. Sanderæ (pink)	18	ca. 40
N. Rusbyi	24	ca. 33
Petunia violacea	14	ca. 7
N. rustica	48	ca. 10–12

[1] The environmental conditions and even the age of the plant influence somewhat the length of the styles.

Petunia violacea is a species very closely related to those of the genus *Nicotiana*. It has a very short style, though its pollen-tubes reach easily the ovaries of *N. Langsdorffii*, *N. Rusbyi*, *N. paniculata*, *N. glutinosa*, *N. glauca*, and even that of *N. Tabacum*, while the pollen-tubes of all these *Nicotiana* species cannot reach the ovary of *Petunia*. It is probably because *Petunia* has only $n = 7$ and $2n = 14$.

From the data here reported we can conclude that the thickness of the pollen-tubes plays an important rôle in the species and variety crosses; the thicker pollen-tubes grow slower than the thinner ones. When we eliminate the factor "length of the styles" by considering only such species that have approximately the same length of the styles one sees the following tendency: the pollen-tubes, originating from species that have larger chromosome number, grow slower in the styles of species having smaller chromosome number, than those originating from species with smaller chromosome number, when growing in styles of species with larger chromosome number. Consequently, a species cross A×B would be more successful than its reciprocal B×A, when A has larger chromosome number than B, because the pollen-tubes of B reach easier the ovary of A than in the reverse cross.

Literature.

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Kostoff, Dontcho, 1930. "Ontogeny, genetics and cytology of *Nicotiana* hybrids." *Genetica* (The Hague), **12**, 33-139.

Kostoff, Dontcho and Prokofieva, A. A., 1934. "Studies on pollen-tubes.—I." *Bull. Laborat. Genet. Acad. Sci. Leningrad*, **10**.

Recent Developments in "Aero-Electrics".

By T. D. Chatterji,

Department of Electrical Technology, Indian Institute of Science, Bangalore.

THE alarming rate at which the world's supply of coal and oil is being used up, persuades the industrialists to assess its reserves: of what may be regarded as inexhaustible power-producing materials, such as wind, tide, solar energy, timber and all vegetable products capable of yielding alcohol. The scarcity of fuel caused by the war has revived the interests of engineers, specially towards the immense and ever present power which is available in the winds. At present many people regard wind-power as of negligible importance, but the intensive researches carried out in various countries lead to the fact that wind is a much more dependable source of power than hitherto expected. The entire water-power resources of the world would be negligible against the gigantic potentialities of wind power. Given proper conditions, it can be turned to a very practical account. Russia has already ascertained that the winds blowing over the Soviet Union contain a potential generative power of some 10,000 million KW. Previously the feasibility of erection of windmills was only possible in low-lying countries as in Holland where a wind of medium strength is almost constantly blowing; and innumerable mills like these are already under successful operation in various countries, not as an industrial concern but as small units for isolated communities. Amongst the scientific investigators the name of the Danish physicist Professor Poul la Cours comes first being the pioneer, but the aircraft industry is solely responsible for enabling the manufacturers to be certain about the actual performance of their windmills in accordance to the designs.

The meteorological data for selecting the most favourable spot with known nature of the disposable wind energy previous to the erections of windmills is as essential as the hydro-electric survey before launching a water-power scheme. Actually the central Aero-hydrodynamic Institute of Moscow has already kept themselves busy in obtaining information about their country through the agency of 1,387 meteorological observatories and at the same time striving to improve the machinery, designed and constructed for the wind-power establishments. At present we can look upon three types of wind-power generators which will enable the electric energy supply on a commercial scale: (1) The improved form of those found to be most suitable by Danish people empirically; (2) The Rotating Cylinder invented by J. D. Madaras, an U.S.A. engineer; the principle being the same as employed by A. Flettner for propelling his wind-driven rotor ship; (3) The high-zone-wind-Power Stations where the wind turbines will be placed as high as 1,500 ft. above the ground surface.

TYPES OF WHEEL.

The maximum amount of power which can be extracted out of the air depends on suitably designing the blade-form concerning its effective area and profiles. These wheels are divided into two classes: *viz.*, slow or high speed runners. A high-speed runner evidently differs from a slow-speed one in having very few long and narrow blades. Governing of speed is generally done by a couple of springs in the former, while an auxiliary vane mounted normally brings the desired effect for the latter. Only very recently the invention of 3–6 bladed fast rotors with automatic adjustable propeller profiles (Fig. 1) have rendered the use of storage accumulators unnecessary.

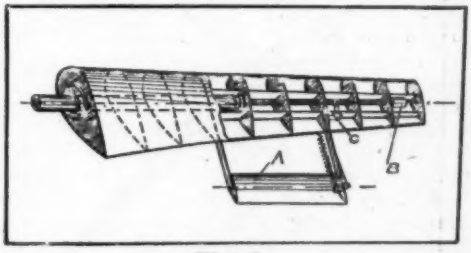

Fig. 1.
Stream-lined self-regulating blades.

Besides the successful operation in Baku of a 45 ft. diameter windmill (Fig. 2) in connection with oil industry, the improvised experimental wheel of 100 ft. diameter at Balaklava in Crimea (Fig. 3) has satisfactorily withstood a year of continuous operation, under the rigours of climatic variations, thereby firmly establishing the possibilities of utilising the energy of the

wind in parallel with the existing hydro-electric plants, particularly in winter when

Fig. 2.
45 feet diameter windmill in Baku.

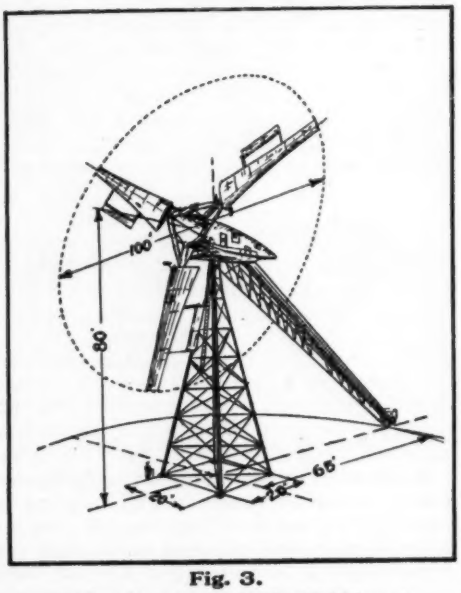

Fig. 3.
100 feet diameter windmill in Balaklava.

in cold countries many rivers, supplying hydro-electric schemes, are ice-bound. Both of them are fitted with three self-regulating blades as shown in Fig. 1. Here the weight B controls the pitch of the blades for constant speed centrifugally in relation with the wind velocity changes, by governing the movements of A through the lever C. The stream-lined blades made out of light wood and metal at Balaklava are each 35 ft. long with the greatest width of 7·5 ft. The inclined shaft of this 100 ft. wheel has been geared with an asynchronous 100 KW. generator rated at 220 volts, 3-phase, 50 cycles, 600 syn. r.p.m. with a power factor of 84 per cent. Special thrust bearings have been provided to compensate the inclination. The machine room is housed inside a steel framed structure and the whole rotates on a spherical pivot on top of the 85 ft. high tower. The structure is connected with a tail-piece (containing the ladder) which terminates on a motor driven platform rotating on a circular track of 65 ft. radius. The motor on the platform is automatically actuated by a directional vane over the machine room to throw the wheel into the wind. When the unit arrives at synchronous speed the generator is automatically cut in, and after the wind dies down the generator is automatically cut out until the wind rises again. The safety of the equipments is assured by means of an automatically controlled protective system. Three phase 220 volts power is transmitted from the generator by a sliding connection and cables to the power house for stepping up to 6·6 KV. for the network. Low voltage generation was adopted for the safety of the experimenters. The erection of a 30,000 KW. set is under schematic form in view of the extreme dependability of this set.

ROTATING TOWERS OF J. D. MADARAS.

This unique contrivance is the outcome of a very recent enterprise. An industrial plant according to the proposed scheme will consist of twenty or more duraluminium cylinders, each 90 ft. high and about 25 ft. in diameter, capped on the top by discs extending 5 ft. beyond its circumference (Fig. 4) and so mounted on bearings that it can turn freely. Each will be placed on a truck and independently driven by a small motor. The towers being smooth surfaced and at the same time moving in a stream of air is bound to develop an increased translational force in accordance with "Magnus Effect", an experimental fact after the German physicist

Magnus, who first demonstrated it in 1852. This force will be utilised in driving the trucks around a circular track and the production of electric power will be effected by huge generators geared to the wheels. Even a wind velocity of 10 m.p.h. is able to produce a peripheral velocity of 50 m.p.h. in the tower. Each such unit will weigh 150 tons and can be depended upon to generate 1,000 KW. On the basis of preliminary calculations it is claimed that the installation costs per KW. will be only about £10, $\frac{1}{4}$th the average cost of a hydro-electric plant. By establishing such generating stations in specially windy location, we can tide over the greatest problem—what to do when the wind refuses to blow?

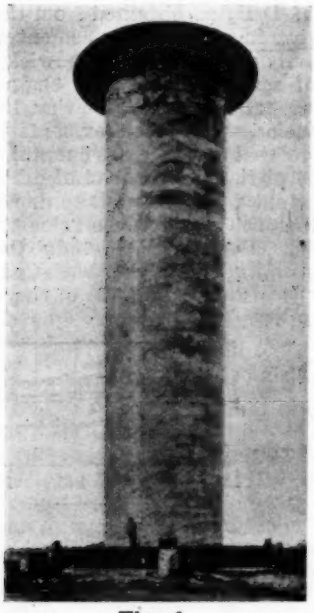

Fig. 4.

The experimental rotor of Madaras in New Jersey.

HIGH-ZONE WIND POWER STATIONS.

This is the last and a very bold attempt on the part of a German engineer Herr Herman Honnef to harness the wind for power. With the materialisation of this plan the question of a favourable and suitable location can easily be dispensed with as there is always plenty of wind high above the earth's surface. The idea is to erect five "windmills" on the top of a colossal tower 1,500 ft. high made out of welded steel tubes. Each will be 250 ft. in diameter and the unit is speculated to generate 50,000 KW.

The modified electric generators have already assured the future of small windmill installations, as hundreds of them have been giving good service for a period of years. Also the difficulties in the regulation of big wheels especially in storms, and direct linking to high voltage transmission systems, are sure to be surmounted within a very short time due to the sincere interest evinced by engineers all over the world to obtain the cheapest energy from nature.

Lyochromes.

RECENT work on the chemistry of a new group of pigments of great physiological importance, now called Lyochromes, has yielded very valuable information regarding their constitution (*Nature*, 1934, **133**, 553-56). These animal pigments are related to Warburg's respiratory ferment on the one hand, and to vitamin B_2 on the other. They are insoluble in the common neutral organic solvents but are soluble in water, and exhibit a characteristic yellow-green fluorescence which changes reversibly to a violet fluorescence on addition of acids or alkalies. Further, they are reversibly reduced to a leuco-base by reducing agents such as hydrosulphite while being highly resistant towards oxidising agents.

One of the richest sources of these pigments is whey from which they can be adsorbed by fuller's earth. The adsorbate can be washed with alcohol and water and eluted by pyridine. By employing this technique, Ellinger and Koschara obtained concentrates from which five crystalline coloured substances designated lactoflavines *a–e*, were isolated. These five substances differ from each other in their crystalline form, solubility and intensity of colour in solution. The flavines *a*, *b* and *c* answer the murexide test and on warming in solution decompose into soluble pigments and substances of a purin character; they are therefore called purin-lyochromes. Lactoflavine *d* gives a negative murexide test while *e* gives the test only with chlorate and hydrochloric acid. B. N. S.

Letters to the Editor.

The Anomalous Scattering of α-Particle.

IN a recent paper[1] on the anomalous α-scattering I have established the following formula:—

$$D/D_\circ = \left[1 - \frac{\frac{4\pi^2 r_\circ^2}{\lambda^2}\,\mathrm{Sin}^2\theta/_2}{\mathrm{Cos}\left(\frac{4\pi r_\circ}{\lambda}\,\mathrm{Sin}\,\theta/_2\right)}\right]^2 \quad \ldots (1)$$

where $D_\circ$ denotes the number of particles scattered with Coulomb force, D the number when the additional polarisation force is supposed to vary as $1/r^5$, θ the angle of scattering, λ the wave length and $r_\circ$ the closest distance of approach of the α-particle from the centre of the nucleus. The values of $D/D_\circ$ as obtained from the above formula are in very good agreement with the experiments of Bieler and Chadwick for all angles of scattering. It was suggested in the paper referred to above that the small discrepancies, where such existed, between the calculated and experimental values might be obviated if instead of taking $r_\circ$ to be a constant we assumed it to depend on θ and also on the range or the velocity of the α-particle. Here I shall study the small variation of $r_\circ$ with the variation (1) of velocity (see Fig. 1) and (2) of the angle of scattering (see Fig. 2).

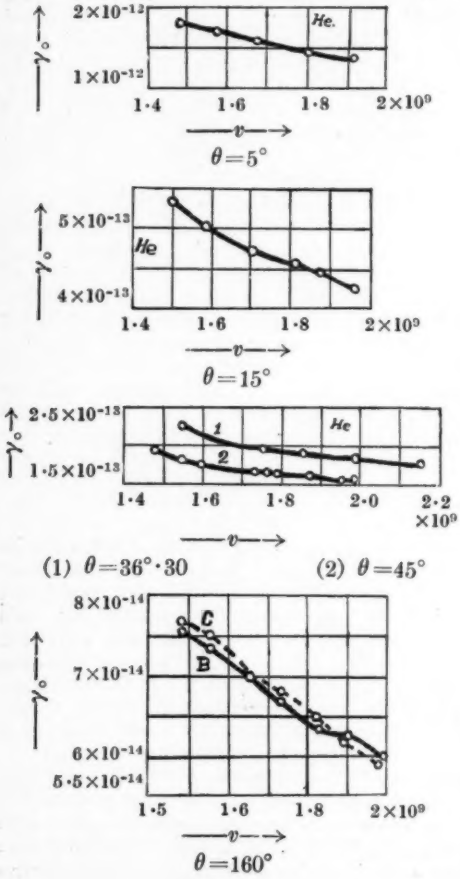

Fig. 1.

[1] *Phys. Zeit.*, **34**, 175, 1933. See also *Current Science*, page 217, January 1933.

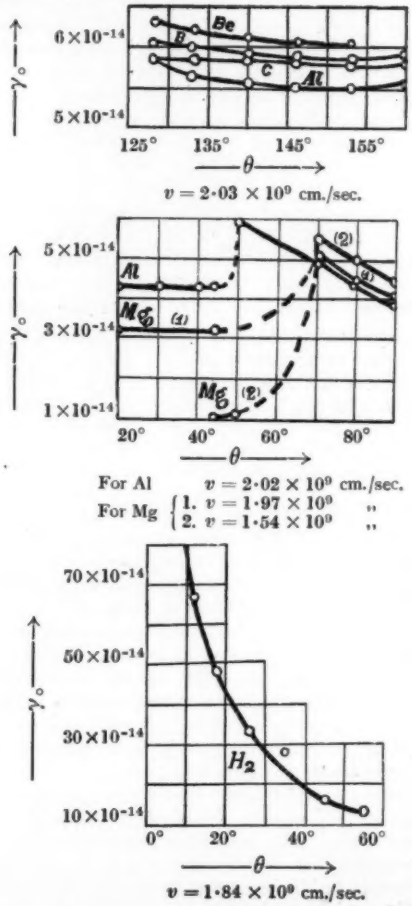

Fig. 2.

In determining these small variations the theoretical values of D/D_0 have always been made to agree with the experimental values.

It will be seen from the curves that in all cases r_0 slightly decreases with the increasing normal component obtained on multiplying the incident velocity by $\text{Sin } \theta/_2$. This is as it should be, when we remember that the α-particle moves against the repulsive force of the nuclear charge. The curves, with the exception of those obtained from Bieler's data, are quite interesting in as much as they are not only continuous but are all of the same type. The curves obtained from Bieler's data are all characterised by anomalous discontinuities. The curve for Aluminium from Bieler's data from observations at small angles has a discontinuity whereas that for the same element from Chadwick's data at large angles is free from any discontinuity. One might be tempted to conclude from this that Chadwick's data are more reliable than those of Bieler. In the case of Hydrogen and Helium the theoretical value of r_0 for small angle scattering is about ten times the value for large angle. It is remarkable that this is nearly the ratio obtained by Rutherford and Chadwick[2] for Helium. From the curves generally and especially from those obtained from the more up-to-date data of Chadwick[3] and Reizler[4] we see that r_0 is practically a constant which was the standpoint taken up in my previous paper and which, as has been shown there, gave a very good agreement with the experimental results. For exact agreement, however, r_0 varies slightly with the variation of the angle of scattering and also with the velocity of the α-particle. The nature of this small variation, it appears, will remain inexplicable so long as the yet undiscovered facts about the structure of the nucleus are not forthcoming.

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Serampore College,
Serampore,
Bengal.
April 27, 1934.

[2] Rutherford and Chadwick, *Phil. Mag.*, **4**, p. 605, 1927.

[3] Chadwick, *Proc. Roy. Soc.*, **134**, 154, 1931.

[4] Reizler, *Proc. Roy. Soc.*, Nov. 1931.

The Wave-Statistical Theory of Artificial Disintegration.

IN a recent paper[1] we have given a theory of the spontaneous disintegration of the α-particle. It is in very good agreement with the experiment. The theory is based on the perfectly natural assumption that the phase density for the hard core within the nucleus is very great compared with the surrounding. Consequently, the statistical waves set up there are damped just as the hydrodynamical waves in a viscous fluid. Here the damping coefficient and so the viscosity effect is positive.

Now it may happen, specially for lighter elements, that under certain conditions the phase-density for the hard core is extremely small compared with the surrounding. This evidently occurs when the nucleus is bombarded by the α-particle and after sufficient penetration it is captured by the core. It is easily seen that in such a case of capturing the damping coefficient for the core should be taken negative. There is no difficulty in imagining a negative damping coefficient or a negative viscosity-effect when it is remembered that they are all relative.

It may be mentioned in this connection that it follows from the fundamental law of duality in nature that if anything, *e.g.*, the damping coefficient, is positive there must exist some phenomenon which corresponds to its negative value. This, in fact, is what Dirac calls the 'Duplexity phenomena'.

From what has been said it is obvious that the artificial disintegration of protons by the lighter elements may be looked upon as a double process of capturing of the α-particle by the core followed by spontaneous emission of the protons. Now in our previous theory the relevant differential equations involve the square of the damping coefficient. So they are unaffected by its negative value. Thus the extension of the previous theory to the present case is almost immediate and we have,

$$\lambda = \text{C.} \frac{\sqrt{E_1 E_2}}{\hbar^2 \gamma^2_{01} \gamma^2_{02} \text{Cot } u_{01} \text{ Cot } u_{02}} \times$$
$$exp. -\{2k_1(2u_{01} - \text{Sin } 2u_{01}) - 2k_2(2u_{02} - \text{Sin } 2u_{02})\}$$

where the suffixes 1 and 2 are respectively for the α-particle and the proton. The different symbols have the same meaning as in our recent note in *Current Science*.[2]

[1] *Phil. Mag.*, **16**, 1097, 1933.

[2] K. C. Kar, *Curr. Sci.*, **2**, 387, 1934.

The agreement of the above formula with the experiment is highly satisfactory as is obvious from the curves for nitrogen and fluorine in which the experimental curve is dotted where it departs from the theoretical. For verification of both the parts of the formula we have taken two cases (1) protons of given velocity emitted by nitrogen when bombarded by α-particles of different velocities, and (2) protons of different velocities, emitted by fluorine when bombarded by α-particles of a given velocity.

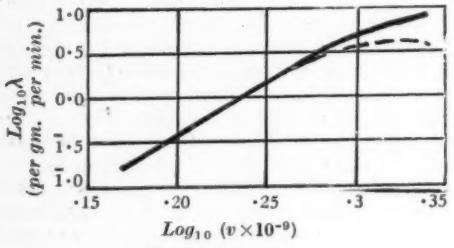


Fig. 1.—Nitrogen.

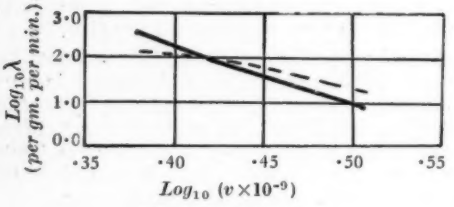


Fig. 2.—Fluorine.

The data are taken from *Radiation from Radioactive Substances*, by Rutherford, Chadwick and Ellis, and also from the publication of Chadwick and collaborators.[3]

In conclusion we may mention that as far as we know the above is the only formula of its kind.

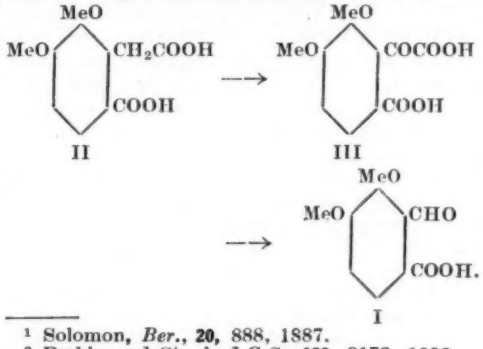
K. C. KAR.
A. GANGULI.

Physical Research Laboratory,
Presidency College,
Calcutta,
April, 1934.

[3] Chadwick, Constable and Pollard, *Proc. Roy. Soc.* **130**, 463, 1931.

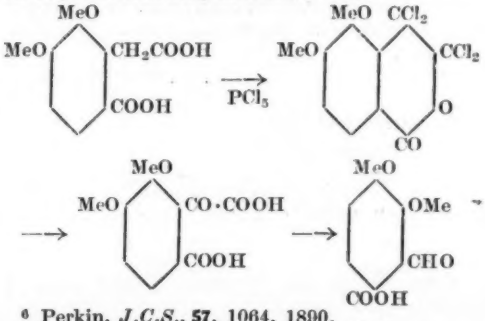
A Synthesis of ψ-opianic acid, and a new general method of Synthesising Phthalonic Acids.

NUMEROUS unsuccessful attempts have been made in the past to synthesise ψ-opianic acid (I) [1-5,*] ψ-Opianic acid which had been first obtained by Perkin by the hydrolysis of Berberal[6] and which has been more recently obtained by the oxidation of β-Pseudo-gnoscopine[7] has now been synthesised by us by a simple method which should be capable of wide extension. The method consists in boiling 5:6-dimethoxyhomophthalic acid (II) with equimolecular quantity of selenium dioxide in Xylene solution when the phthalonic acid (III) is obtained in excellent yields. The phthalonic acid was readily converted into ψ-opianic acid through its sodium bisulphite compound under the conditions previously described by one of us[8].



[1] Solomon, *Ber.*, **20**, 888, 1887.
[2] Perkin and Stoyl, *J.C.S.*, **123**, 3173, 1923.
[3] Edwards, Perkin and Stoyl, *J.C.S.*, **127**, 196, 1925.
[4] Chakravarti, *J. Ind. Chem. Soc.*, **6**, 208, 1929.
[5] Robinson, "On Life and Work of Perkin," p. 80.

* We have also synthesised ψ-opianic acid through the following alternative route:—



[6] Perkin, *J.C.S.*, **57**, 1064, 1890.
[7] Robinson, *J.C.S.*, 1376, 1932.
[8] Chakravarti, *J. Ind. Chem. Soc.*, **10**, 696, 1933.

The acid thus obtained had all the properties of ψ-opianic acid obtained by Perkin. For confirmation of its identity it was reduced to ψ-meconine m.p. 124, and also converted into its oxime, m.p. 124 and hemipinimide. The mixed melting point of these derivatives with the corresponding authentic specimens caused no depression.

The oxidation of several other homophthalic acids to the corresponding phthalonic acids by means of Selenium dioxide has also been studied. In every case an excellent yield of the phthalonic acid is obtained. Homophthalic acids being readily available substances, this new method of synthesis should prove to be a valuable one.

S. N. CHAKRAVARTI.
M. SWAMINATHAN.

Annamalai University,
May 2, 1934.

Changes in the Charge on Colloidal Particles during Dialysis of Sols.

IN papers* published from our laboratory we have put forward the view, on the basis of experimental evidence, that a colloidal solution when subjected to dialysis will show first an increase and then a decrease or a continuous decrease in the cataphoretic speed according as the amount of the peptising electrolyte initially present is more, or equal to or less than the amount corresponding to the maximum in the cataphoretic speed-concentration curve of that sol with the particular (peptising) electrolyte. Colloidal solutions of gold, ferric hydroxide and thorium hydroxide have been found to conform to this behaviour. S. G. Chaudhury† has also observed in the case of colloidal solution of copper ferrocyanide containing very high concentrations of potassium ferrocyanide that with the progress of dialysis the cataphoretic speed first increases and reaches a maximum after which it decreases.

We have been investigating other collodial solutions from the point of view stated above and have observed that the prussian blue sol (peptised with oxalic acid solution) when subjected to dialysis shows a behaviour similar to the colloidal solutions of gold, ferric hydroxide, thorium hydroxide and copper ferrocyanide. In the case of arsenious sulphide, however, on subjecting the sol to dialysis, the cataphoretic speed first decreases and reaches a minimum, then increases and reaches a maximum and afterwards again decreases. The sol was so prepared that it did not contain initially any free arsenious acid. The dialysis was carried out in a dark place to avoid effect of light on the sol. On analysing the various samples of the sol used in cataphoretic speed determinations, it was found that the amount of arsenious acid increased with the progress of dialysis till the cataphoretic speed decreased; after the minimum value of cataphoretic speed was reached the amount of arsenious acid began to decrease, apparently due to further hydrolysis stopping and arsenious acid passing out in the dialysate. S. N. Mukherjee‡ has observed that the cataphoretic speed of arsenious sulphide decreases on the addition of arsenious oxide to the sol. The initial decrease in the cataphoretic speed with an increase in the amount of arsenious acid due to hydrolysis of the sol noticed by us therefore agrees with the observations of S. N. Mukherjee. The subsequent increase in the cataphoretic speed may be due to a decrease in the amount of arsenious acid as well as the peptising sulphid-ions and hydrosulphid-ions and the final decrease due to a considerable decrease in the amount of the peptising ions. Detailed results will be published elsewhere in due course.

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Bombay 7,
May 11, 1934.

Development of Vertebral Column in Fishes.

PROF. MACBRIDE[1] reviewing my work[2] on the "Development of the Vertebral Column in Fish" expressed a doubt as to the correctness of my view in regard to the origin of the zygapophyses in the fish. He wrote: "Ramanujam describes these (the zygapophyses) as vertical outgrowths of the 'outer

* Desai, Nabar and Barve, *J. Ind. Chem. Soc.*, **9**, 463, 1932; Desai and Borkar, *Trans. Faraday Soc.*, **29**, 1269, 1933; and B. N. Desai and A. K. Desai, *ibid.*, **30**, 265, 1934.

† S. G. Chaudhury, *J. Ind. Chem. Soc.*, **10**, 431, 1933.

‡ S. N. Mukherjee, *Kolloid Z.*, **53**, 159, 1930.

[1] MacBride, E. W, "Recent Work on the Development of the Vertebral Column," *Biological Reviews*, Cambridge, **VII**, 1932, pp. 108–148.

[2] Ramanujam, S. G. M., "The Study of the Development of the Vertebral Column in Teleosts, etc.," *Proc. Zool. Soc.*, 1929, pp. 365–414.

bony ring', *i.e.*, the perichordal centra 'formed directly from connective tissue' and later he states that the basi-dorsals of each segment is connected with its zygapophyses by a 'bony ridge'. The whole matter requires re-examination and restatement. The strong probability is that Ramanujam is mistaken as to the origin of the zygapophyses. If, as seems probable, they are formed as extensions of the supra-dorsals then these pieces will correspond to the so-called 'dorsal inter-dorsals' of the higher forms." ([1]pp. 120-121.)

A re-examination of my preparations only served to confirm me in my views. I was therefore glad to receive a communication a little later from Prof. MacBride confirming my view. As it is of zoological interest, I give below the relevant portion of his letter:

> "We have found that you are quite right about the zygapophyses which you described as outgrowths from the centra. This is true and in my judgment these outgrowths are the missing intercalaria. They have nothing whatever to do with the zygapophyses of the higher forms which are outgrowths from the arches and correspond to what Prof. Piiper called the dorsal inter-dorsals. This is a remarkable example of parallel evolution and one which I did not expect to find."

I am afraid I have also to adhere to my view that the paired cartilages adhering to the inner sides of the basi-dorsals and supporting the dorsal longitudinal ligament are probably equivalent to the supradorsals of other forms, a view which Prof. MacBride regards as requiring further investigation. ([1]p. 120.) Their unusual position has naturally given room to some scepticism as to the correctness of my view. This unusual position is due to the enormous development, dorsal to the spinal cord, of a longitudinal ligament which is rarely so well developed, if at all, in most other forms. This has necessitated a structure to separate and protect the spinal cord from the dorsal longitudinal ligament. This need has been met by the supradorsals which in higher forms form the neural spine being shifted to a more ventral position and the basidorsals themselves being continued up, instead, to form the spine. The supra-dorsals shifted to a more ventral position still form the roof—a protecting roof—for the soft spinal cord as in other and higher forms. At the same time, they serve as props on which the enormously developed ligament rests. The supra-dorsals which in higher forms, *e.g.*, Amphibia, are single and median retain here in *Clupea* the primitive paired condition. It will be noted that the neural cavity which in most forms is single is here in *Clupea* divided into two channels—an upper vertebral channel enclosing the ligament and a lower larger canal enclosing the spinal cord—by the development of these paired cartilages inner to the basi-dorsals and at the level between the ligament and the spinal cord.

More recently, Mookerjee[3] has sought to question the accuracy of my observations on the development of the intervertebral ligament, as they do not coincide with his observations in *Ophiocephalus*. *Ophiocephalus* is a specialised form and as I pointed out at the commencement of my paper,[2] the interest of my investigation lay in the fact that I took a generalised form which naturally has shown conditions more primitive and of phylogenetic importance than the work of previous authors which, like Mookerjee's observations now on *Ophiocephalus* were all on specialised forms which have "relatively large eggs and shortened development[1]".

S. G. MANAVALA RAMANUJAM.

Department of Zoology,
Presidency College,
Madras,
May 14, 1934.

Vitamin B_2 and a New Flavin in Ox-Kidney Extracts.

DURING recent years we have been trying to get a highly concentrated preparation of Vitamin B_2 from ox-liver and ox-kidney.* Meanwhile, R. Kuhn *et al*† (*cf.* also Ellinger and Koschara‡) have succeeded in the isolation of two water-soluble, crystalline pigments, which they have termed ovoflavin and lactoflavin, from egg-white and whey respectively. These are yellow-red substances, exhibiting strong green fluorescence in aqueous and acid solutions and are said to be the most active preparations of Vitamin

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[3] Mookerjeé, H. K., "On the Development of the Intervertebral Ligament in Teleostean Fishes," *Curr. Sci.*, pp. 342-343, 1934.

* Guha, *Biochem. J.*, **25**, 945, 1931; Guha and Chakravorty, *Ind. J. Med. Res.*, **21**, 211, 1932; Guha and Chakravorty, *J. Ind. Chem. Soc.*, **11**, 295, 1934.

† *Ber.*, **66B**, 576, 1034, 1950 (1933).

‡ *Ber.*, **66B**, 808, 1933.

B_2 so far recorded. K. G. Stern§ has also obtained a similar pigment, hepatoflavin, from horse-liver. These pigments, termed "flavins" by Kuhn, apparently belong to a group of water-soluble natural colouring matters called lyochromes (Ellinger).

Starting from a concentrated aqueous extract of ox-kidney (50 kg.), and following approximately the methods of Kuhn—by adsorbing on Fuller's earth in acid solution, eluting with a mixture of pyridine, methanol and water, purifying with picric acid and further over silver salt—we have obtained a yellow-red hygroscopic solid showing strong green fluorescence in aqueous and acid solutions. An impure fraction of the substance at the final stage produced good growth in young Vitamin B_2-deficient rats in daily doses of 0·2 to 0·3 mg. One of these concentrated fractions of Vitamin B_2, when dried in the vacuum desiccator and placed under the microscope, was found to consist in large part of yellow-coloured prismatic needles. Considerable difficulty was experienced in the preparation of the pure substance owing to its sensitiveness to light. This crystalline substance apparently belongs to the lyochrome group of pigments and may be called "Renoflavin". Its relation to the other flavins and to Vitamin B_2 is under investigation.

B. C. GUHA.
H. G. BISWAS.

Biochemical Laboratory,
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Works, Ltd., Calcutta,
May 22, 1934.

Diamagnetism and Molecular Association in Organic Liquids.

THERE are many important problems connected with the diamagnetism of liquids which need satisfactory solutions. One of these is the question whether molecular association in organic liquids affects the diamagnetic susceptibility.

Although several investigators[1] have observed variations from the additive law in the case of organic liquid mixtures, it has been consistently found in this laboratory that no such variations exist. Rao and Sivaramakrishnan[2] using a Curie balance observed that the additive law was obeyed to within ½%. More recently one of us (S. R. R.) repeated the measurements with great care using a new method in which a combination of the Guoy and the Curie methods was adopted and in which the volume susceptibilities were directly compared. It was found that the mixtures followed the additive law to within ⅛%. Kido[3] has recorded similar observations and shown that variations occur only when a change in the nature of the carbon link takes place in the molecules concerned.

If there is a genuine variation from the additive law in the case of mixtures of acetone-chloroform and acetone-nitrobenzene and if this variation is due to a gradual break-up of association caused by the presence of the foreign molecules, temperature variations should profoundly affect the departures from the additive law. One of us (P. S. V.) has investigated the diamagnetism of typical organic liquid mixtures by the Quincke method at different temperatures ranging from 15°C. to about 75°C. It was found that the mixtures of acetone-chloroform and acetone-nitrobenzene gave straight line graphs between the specific susceptibility and concentration at different temperatures. The diamagnetic susceptibility of nitrobenzene showed no variation as its temperature was raised, a result which accords well with that of Cabrera and Fahlenbrach,[4] but which disagrees with the observations of Mathur[5] and Rao and Sriraman.[6] The new investigations were made at fields (25,000 gauss) much higher than those used by them. The meniscus conditions and the corrections involved were carefully studied theoretically and experimentally. These corrections appear to become very large at low field strengths and give rise to spurious variations. The X-ray diffraction studies of Todd[7] on nitrobenzene at different temperatures lend confirmation to these observations.

There is one other point in this connection which needs some elucidation. Some investigators have mentioned that in the case of mixtures of organic liquids whose molecules have large electric moments the mutual influence caused by neighbouring

§ *Nature*, **132**, 784, 1933.

[1] For full details of previous literature see *Ind. Jour. Phys.*, **7**, 393, 1932.

[2] *Ind. Jour. Phys.*, **6**, 509, 1932.

[3] *Sci. Rep. Tok. Imp. Univ.*, **21**, pp. 149, 288 and 869, 1932.

[4] *Zeits. f. Phys.*, **85**, 568, 1933.

[5] *Ind. Jour. Phys.*, **6**, 207, 1931.

[6] *Ind. Jour. Phys.*, **8**, 315, 1934.

[7] *Phys. Rev.*, **44**, 794, 1933.

fields may alter the diamagnetic susceptibility. It is difficult to see how this could happen. Such an argument is not tenable since it can be shown that change of state from liquid to vapour does not produce any large change in the susceptibility value. Vaidhianathan's[8] results apparently show some such variations in the case of certain liquids but our calculations indicate definitely that if instead of assuming that a volume of 22·24 litres of the saturated vapour at N.T.P. has the molecular mass (an obviously untenable assumption in the case of saturated vapours), we directly calculate the specific susceptibility from the density data of the saturated vapour (taken from the tables) the liquid and the vapour values agree to within the limits of experimental error. We have also in progress investigations on the diamagnetism of vapours based on the methods developed in this laboratory to test these conclusions rigorously. If therefore change of state from liquid to vapour does not produce any appreciable change in the susceptibility value, it follows that at least in magnetic measurements of this kind, the mutual influence of molecular electric moments is negligible. These considerations along with those outlined at the beginning show clearly that any variation from the additive law in organic liquid mixtures is highly improbable and that association does not affect the specific diamagnetic susceptibility in the case of organic liquids.

Full details are being published elsewhere.

S. RAMACHANDRA RAO.
P. S. VARADACHARI.

Annamalai University,
Annamalainagar,
May 24, 1934.

Photo-Dissociation of the NO_3^- Ion and its Dependence on the Polarisation of the Exciting Light-Quantum.

AQUEOUS solutions of several nitrates have been studied for their absorption spectra in the ultra-violet. They all show two absorption bands, one feeble extending from 350 $m\mu$ to 270 $m\mu$ with a maximum at 300 $m\mu$, and a second absorption which is very much stronger, beginning at about 230 $m\mu$ and having its maximum at 206 $m\mu$[1]. Following the explanation given by Henri and his collaborators[2] for the absorption spectra of NO_2, SO_2, CS_2 and other molecules, and of Dutta[3] for SO_3 and N_2O_5 we may attribute the origin of the two absorption bands of the NO_3^- ion to the following photo-chemical reactions. The absorption which begins at 350 $m\mu$ may be taken to correspond to the photo-dissociation of the NO_3^- ion into NO_2^- ion and oxygen atom in the ground state ($^3P_2$) according to the relation

$$NO_3^- \rightarrow NO_2^- + O(^3P_2) - 81 \text{ K cals. } (350\ m\mu). \quad (1)$$

From thermochemical data[4] we have

$$NO_3^- \rightarrow NO_2^- + \tfrac{1}{2}O_2 - 24 \text{ K cals.} \quad .. \quad (2)$$

From (1) and (2) we obtain

$$\tfrac{1}{2}O_2 \rightarrow O(^3P_2) - 57 \text{ K cals.} \quad .. \quad .. \quad (3)$$

which gives for the energy of dissociation of the O_2 molecule into two unexcited O atoms, the value 114 K cals. This agrees with the value 114·6 K cals. recently obtained by Henri[2] from the predissociation limit of NO_2.

The second absorption band, which begins at about 230 $m\mu$, may be taken to correspond to the dissociation of NO_3^- into NO_2^- and an *excited* O atom according to the relation

$$NO_3^- \rightarrow NO_2^- + O(^1D_2) - 124 \text{ K cals. } (230 m\mu). \quad (4)$$

From (4) and (1) we obtain

$$O(^1D_2) - O(^3P_2) = 43 \text{ K cals.} \quad .. \quad (5)$$

This again agrees with the value 45·1 K cals. obtained from spectroscopic measurements by Frerichs, Hopfield and Paschen.[5]

The photodissociation due to the 206 $m\mu$ absorption band is confirmed by the direct experiments on KNO_3 solutions by Warburg[6] and others; a feeble effect has also been claimed with sun-light having

[8] *Ind. Jour. Phys.*, **2**, 135, 1927.

[1] For a typical absorption curve for the nitrate solutions see Fig. 1. Maslakowez, *Zeits. Phys.*, **51**, p. 703, 1928; Fig. 2. The values given in the present letter for the wave-lengths corresponding to the beginnings of the two absorption bands and their maxima, are taken from this curve of Maslakowez.

[2] See article on "Pre-dissociation" by V. Henri, *Leipziger Vortrage*, 1931, English translation, Blackie, pp. 121-143.

[3] *Roy. Soc. Proc.*, A., **137**, p. 366 and **139**, p. 397, 1932.

[4] *Int. Crit. Tables*, **5**, p. 178.

[5] See Bacher and Goudsmit, *Atomic Energy States*, p. 333. The term values for the $^3P_2$ and $^1D_2$ levels are 109,837 and 93,969 cm^{-1}, so that their difference is equal to 15,868 cm^{-1} or 45·1 K. cal.

[6] *Sitz. Ber. Berliner Akad.*, 1918, p. 1242.

wavelengths greater than 290 $m\mu$, which may be attributed to the 300 $m\mu$ band absorption.

The absorption spectra of nitrates in the crystal state and in the fused state have also been studied, and the absorption curves are very similar to those obtained with aqueous solutions. Thus in these states also, the absorption bands have presumably the same origin and are due to the two types of photo-dissociation of NO_3^- described above.

It is remarkable that when the absorption measurements are made with *single crystals* of KNO_3 and $NaNO_3$, in which the NO_3^- ions are all orientated parallel to one another, the above two absorption bands are very intense when the incident light-vibrations lie in the plane of the NO_3^- ions, while for the vibrations along the normal to the NO_3^- planes the absorptions are much feebler.[7] This experimental result, when considered in relation to the origin of these absorption bands given above, as due to the photo-dissociation of NO_3^- ion to NO_2^- ion and O atom in the ground state and in the excited state respectively, suggests that *the efficiency of the photo-dissociation of the NO_3^- ion is much greater when the exciting light-vibrations are in the plane of the NO_3^- ion than when they are along the normal to its plane.* Experiments are in progress to test this conclusion by direct measurements.

A detailed report of the work will appear in the *Symposium on Molecular Spectra* to be published by the *Indian Academy of Sciences*.

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A. C. GUHA.

210, Bowbazar Street,
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May 28, 1934.

The Metabolism of Carotene: the Possible Role of the Reticulo-Endothelial System.

THE susceptibility of vitamin A-deficient animals to certain infections of a non-specific type is now generally recognised, and though Harris[1] has indicated the probable course of events in the epithelial cells deprived of vitamin A, the root-cause of the defect in the defence mechanism of the tissues is still unknown. An impairment of the functioning capacity of the reticulo-endothelial system has been suggested as the primary effect of vitamin A deprivation, and the experimental studies of Lassen[2] lend a certain degree of support to this view, though it appears that even in advanced stages of vitamin A deficiency the anti-body producing mechanism may still be functioning with effect.[3]

Our observations made during studies on the metabolism of carotene, however, indicate a possible rôle of the reticulo-endothelial system in the animal function of the formation of vitamin A from carotene. On following the course of colloidal carotene injected into the blood stream, it was found to disappear rapidly from the circulation and appeared to be localised chiefly in the liver, the spleen, and to a smaller extent in the lungs, as evidenced by the amount of yellow colour of the ether extract of the tissues. In view of the capacity of these cells for phagocytosis and intracellular digestion it was probable that these cells which abound in the liver and the spleen take up the pigment though histological evidence on this point could not be obtained.*

When carotene was administered to a dog as a course of intravenous injections of the colloidal pigment for a certain period, no increase was noticed in the vitamin A content of the liver (a piece of the liver was removed by a surgical operation before the injections to act as control), while spleen (ordinarily deficient) appeared to contain large stores of vitamin A, almost approaching the liver in its richness.[4] The presence of a large proportion of the pigment in the spleen after its injection and later a large store of vitamin A is significant, as this organ while probably the richest store-house of the reticulo-endothelial cells has not been previously known to contain

[7] See Krishnan and Das Gupta, *Nature*, **126**, p. 12 (1930) and *Indian Journ. Phys.*, **8**, p. 49 (1933).

[1] Harris, *Lancet*, **2**, 614, 1932; *Annual Rev. Biochem.*, **2**, 272, 1933.

[2] Lassen "Experimental Studies on the Course of Paratyphoid Infections in Avitaminous Rats, Copenhagen," 1931; *Z. Immunität*, **73**, 221, 1932.

[3] Zilva, *Biochem. J.*, **13**, 172, 1919; Werkman, *J. Inf. Dis.*, **32**, 247, 1923; Werkman, Baldwin and Nelson, *ibid.*, **35**, 549, 1924; Cramer and Kingsley, *B. J. Expt. Path.*, **5**, 300, 1924.

* Professor J. C. Drummond has obtained evidence that the Kupfer cells of the liver and similar cells of the spleen rapidly take up the pigment from the blood after its introduction into circulation (private communication).

[4] Ahmad, Grewal and Malik, *Ind. Med. Gaz.*, June Number, 1934 (*in the press*).

any appreciable amount of the body stores of vitamin A.[5]

A similar observation has been recorded in the case of a cat fed with carotene for a short period, though the concentration of vitamin A in the spleen did not approach the high figure recorded in the case of a dog and was much less than that of the liver. It may incidentally be pointed out that the previous observations of Ahmad[6], Rea and Drummond,[7] and Ahmad and Malik[8] on the inability of the cat to form vitamin A from carotene, may be due to the reason that higher animals like cats and dogs in which the spleen is more highly developed and contains in its meshes a large proportion of the reticulo-endothelial cells (as compared to the liver), vitamin A may appear first in the spleen which those authors omitted to examine. But the question must needs be further investigated.

In the short term experiments[4] in which the increase in the vitamin A content of the liver was taken as the criterion of the formation of vitamin A from carotene administered intravenously, it appeared that it was only in the rabbit that any significant amount of vitamin A formation took place, while it failed in other species of animals. That this should be so, may be due to the probability that the reticulo-endothelial system of the rabbit is functionally more powerful, which is supported by the common observation that of all the experimental animals the rabbit responds more quickly in immunisation experiments.

At the same time one might take into consideration the analogous rôle of the reticulo-endothelial cells in the phagocytosis and ingestion of red-blood cells and the formation of bilirubin.[9] Further analogy is furnished by the rôle of monocytes in anti-body formation from foreign proteins.[10]

There is a striking parallelism between the concentration of reticulo-endothelial cells and the concentration of vitamin A in tissues of the animal body. Liver is a rich store of both. Spleen which might have been an exception is now known to contain relatively large amounts of vitamin A in higher animals particularly after a high carotene intake. Other animal tissues containing appreciable quantities of vitamin A are the adrenals, blood, lungs, bonemarrow, and the kidneys, all of which abound in the reticulo-endothelial cells with the exception of the last named. Of course, it should be taken into consideration that different types of reticulo-endothelial cells may have differentiated functions.

An attempt has been made to study this question further by examining the effects of splenectomy and the blockade of the reticulo-endothelial system in the rat during carotene administration. The results are on the whole inconclusive. The method is fraught with the obvious danger that the blockade or the removal of the reticulo-endothelial cells at one centre would lead to the active proliferation of these cells in other tissues.

This fragmentary evidence presented here is strongly suggestive. It is reported in the hope of stimulating investigations into this question at other centres of research.

B. AHMAD.

Department of Biochemistry
and Nutrition,
All-India Institute of Hygiene
and Public Health,
Calcutta,
May 30, 1934.

[5] Sherman and Boynton, *J. Amer. Chem. Soc.*, **47**, 1646, 1925; Kerppola, *Skand. Arch. Physiol.*, **56**, 181, 1930; Moore, *Biochem. J.*, **25**, 275, 1931; Simmonet and Busson, *Comp. Rend. Soc. Biol.*, **109**, 182, 1932; Davies and Moore, *Biochem. J.*, **28**, 288, 1934.

[6] Ahmad, *Biochem. J.*, **25**, 1195, 1931.

[7] Rea and Drummond, *Z. Vitaminforsch.*, **1**, 177, 1932.

[8] Ahmad and Malik, *Ind. J. Med. Res.*, **20**, 1033, 1933.

[9] McNee, *Quart. J. Med.*, **26**, 390, 1923.

[10] Hekteon and Carlson, *J. Inf. Dis.*, **7**, 319, 1910; Luckhardt and Becht, *Amer. J. Physiol.*, **28**, 257 & 274, 1911; Topley, *J. Path. Bact.*, **33**, 339, 1930.

Notes on the Occurrence of *Grammothele cineracea* Bres. *Kneiffia grisea* Berk. and Curtis.

Grammothele cineracea Bresadola, a member of the family Hydnaceæ, is very common in Bengal; but curiously enough no report as to its occurrence in India has yet been made.[1] This unique and conspicuous species is not rare to a careful observer. It grows on trunks of *Phœnix sylvestris* and other palms, particularly on the persistent leaf-bases near the soil. I have also seen it growing on logs and posts. The fructification is entirely resupinate and crustaceous, characterised by

[1] Butler and Bisby, *The Fungi of India*, 1931.

the hymenium which is distinctly polyporoid. It is closely adpressed to the substratum and extends up to a foot in length. When fresh, the fungus is of dark ash-grey colour with a shining lustre which no one can afford to overlook.

Prof. Burt to whom the specimen was sent has also identified it as *Grammothele cineracea* Bres. He further writes to me to say that this species was first described from specimens collected in Cuba, under the name of *Kneiffia grisea* Berk. and Curtis.[2] Its inclusion in *Kneiffia* was, however, unfortunate. It was next collected by Rev. Rick at Sao Leopoldo, Rio Grande du Sol, Brazil, South America. These specimens were distributed in the exsiccati of Theissen Decades *fungorum brasiliensium*, No. 5. The same species was again reported from the Philippines and described by Bresadola as *Grammothele cineracea*.[3]

The name *Grammothele grisea* Berk. and Curtis should have been the proper nomenclature for this species. But as it is already pre-occupied by another species of the same authors, the type specimen of which was also collected at Cuba and a description published along with that of *Kneiffia grisea* Berk. and Curtis,[2] the comparatively recent nomenclature adopted by Bresadola has been retained for this species. It is very near to *Poria hydnopora* Berk. which, according to some, is a species of *Grammothele* but differs from it in having smaller sub-angular pores and other characteristics.

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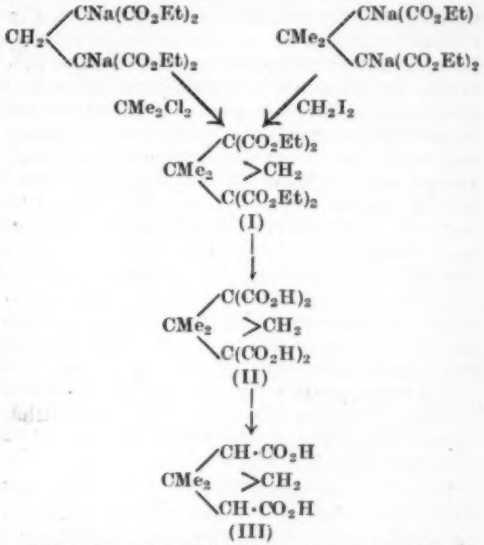
May 30, 1934.

Two New Methods of Synthesis of Norpinic Acid.

THE synthesis of norpinic acid has been achieved by the following two new methods, namely, (1) by the condensation of sodium methylene dimalonic ester and $\beta\beta$-dichloropropane, and (2) sodium derivative of isopropylidene dimalonic ester with methylene iodide.



The tetracarboxylic ester (I) suffered hydrolysis and decarboxylation simultaneously on being boiled with 50 per cent. sulphuric acid yielding *trans*norpinic acid (III) m.p. 145-146° softening at 136°. The tetracarboxylic acid m.p. 200° (II) obtained from (I) by hydrolysis with alcoholic potash was decarboxylated by heating at 220-240° or by boiling with 50 per cent. sulphuric acid. The yields of II and III are poor.

As a result of a large number of experiments conducted under varying conditions, it has been possible to effect considerable improvement upon the methods of preparation of isopropylidene malonic (yield 1315 g. from 1170 g. of malonic ester) and dimalonic (yield 42 g. from 80 of isopropylidene malonic ester) esters described by Clemo and Welch (*J. C. S.*, 1928, 2621).

P. C. GUHA.
K. N. GAIND.

Department of Organic Chemistry,
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Bangalore,
May 31, 1934.

Conversion of *Meso*tartaric Acid into an optically active form by Walden inversion under asymmetric conditions.

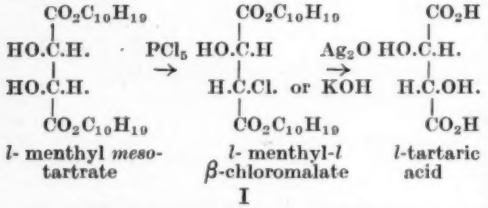
ORGANIC compounds, containing asymmetric centres in their molecule, but inactive due to internal compensation, are generally supposed to be non-convertible into the active

[2] *Journ. Linn. Soc.*, **X**, p. 327, 1868.
[3] *Hedwigia*, **56**, p. 299, 1915.

enantiomerides and there is no mention in chemical literature of any attempt having been made so far to achieve such a conversion. It appeared probable that if by any means the disposition of the atoms or groups attached to one of the asymmetric carbon atoms in an internally compensated compound can be altered, the resulting compound might show optical activity. But any such alteration, tried under normal conditions, by which the internal compensation can be disturbed provides a scope for the production of both the *d*- and *l*-forms in equimolecular proportions giving rise to a racemic product. Just in accordance with this concept, it was found that ethyl *meso*tartrate by the action of phosphorus pentachloride (Anna Rao and Guha, *Ber.*, 1934, **67**, 741) gave diethyl *dl*-β-chloromalate.

To overcome this difficulty, it was planned to study Walden inversion process on *meso*-tartaric acid under asymmetric conditions. If, in place of the ethyl ester, optically active ester groupings are introduced, it is hoped that, under the influence of the active ester groupings there would be formed an excess of one of the two antipodes from which an active product would arise after the ester groups have been knocked out.

An experimental verification of this conception has now been made. *l*-Menthyl *meso*tartrate has been taken as the starting material. The halogenation has been conducted by means of phosphorus pentachloride and hydroxylation by means of silver oxide or alcoholic potash. It has been found that during hydroxylation, the ester groups are also split up and the end product yields a small amount of *l*-tartaric acid according to the scheme:



l- menthyl *meso*-tartrate — *l*- menthyl-*l* β-chloromalate — *l*-tartaric acid

I

The identity of the compound (I) has been confirmed by reducing it in an alcoholic solution by means of aluminium-mercury couple, and hydrolysing the reduction product by potash whereby an acid showing *laevo*-rotation is obtained. There is no theoretical possibility of any optically active acid other than malic acid being formed in this process.

P. C. GUHA.
V. ANNA RAO.
Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
June 9, 1934.

X-Ray Analysis of the Crystal Structure of Dibenzyl.

DIBENZYL crystallises in the monoclinic prismatic class. A preliminary X-ray analysis by Hengstenberg and Mark[1] shows that it belongs to the space group C_{2h}^5 with two molecules in the unit cell; the molecules possess a centre of symmetry. I have made a detailed X-ray analysis of the structure of this crystal, and the positions of the various carbon atoms in the unit cell are as follows: The 6 carbon atoms of each benzene ring form a regular hexagon as in diphenyl[2]; one of the aliphatic carbon atoms, *viz.*, C, (see Fig. 1) lies on the prolongation of the line joining the atoms 4 and 1, and the other

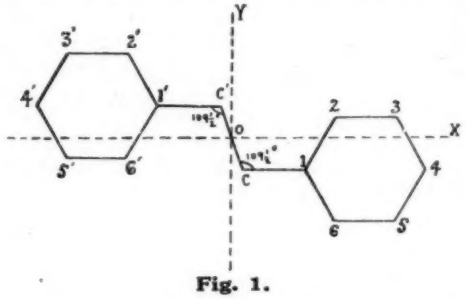


Fig. 1.

on the line joining 4′ and 1′ (adopting the usual notation). The line joining C and C′ makes with each of the above lines (*viz.*, 4 1 and 4′ 1′), the usual tetrahedral angle of $109\frac{1}{2}°$. Further, the two benzene rings do not lie in the same plane, but lie in parallel planes slightly separated from each other. Thus in Fig. 1, all the carbon atoms on the right hand side of OY may be supposed to be raised above the plane of the paper by about 0·12Å, and all the atoms on the left side to be pushed below the plane by the same distance.

In order to define the orientations of the molecules in the unit cell, consider in Fig. 1

[1] *Z. f. Krist.*, **70**, 283, 1929.
[2] *Ind. J. Phys.*, **7**, 43, 1932.

the two perpendicular axes OX and OY lying in the plane of the paper and fixed to the molecule. It is found that the OX axes of both the molecules in the unit cell lie in the *b* (010) plane in the obtuse angle β, making an angle of 32° with the '*a*' axis (and 84° with the '*c*' axis). The OY axes of the two molecules are inclined at *plus* and *minus* 60° respectively to the *b* (010) plane.

The orientations suggested here are identical with those deduced by Krishnan and Banerjee[3] from their magnetic measurements on this crystal. Their values for the above angles are 32° and ± 60° respectively.

The details of the analysis will be published shortly in the *Indian Journal of Physics*.

JAGATTARAN DHAR.

210, Bowbazar Street,
Calcutta,
June 12, 1934.

[3] *Nature*, **130**, 313, 1932.

The Kasauli Antivenene.

By S. D. S. Greval, Major, I.M.S.,
Central Research Institute, Kasauli.

AFTER Calmette had prepared a polyvalent antivenene at the Pasteur Institute, Lille, the preparation of a similar antiserum was commenced at the Pasteur Institute, Kasauli, in 1901. By 1902 "1,020 bottles each containing 15 c.c. were distributed all over India". It was soon realised that excepting the venom of the cobra (*Naia*) the different snake venoms produced antivenenes which were strictly specific: Hence the necessity of preparing an antivenene against the Russell's viper in India. In 1905 the Central Research Institute, Kasauli, took over the preparation of the antivenene from the Pasteur Institute and started issuing to the public a combined antivenene against the cobra (*Naia*) and the Viper (*Vipera russelli*). During the following 29 years the details of preparation and standardization of the serum underwent very little change. The large bulk of antivenene which it is necessary to use has always been a disadvantage and various attempts had been made in the past to get over this difficulty by concentrating the serum. This has now been accomplished and during the present year a concentrated antivenene has, for the first time, been issued for general use. The protecting substance of the crude serum has been concentrated four times and the inert blood proteins have been eliminated. The dose of 10 c.c. issued now represents the 40 c.c. dose of the crude serum issued formerly and makes it possible to administer safely the maximum amount of serum needed for a bite of maximum intensity.

The concentration has been brought about by the application of the standard method of concentration of antisera by ammonium sulphate. The protecting substance is removed from the plasma by a fractional precipitation with the salt. To the oxalated plasma are added 3% of a 4% solution of calcium chloride, two volumes of tap water and about 18% of the total volume so obtained ammonium sulphate, adjusting the specific gravity to 1099. The resulting precipitate (fibrin and euglobulin) is filtered off. To the filtrate is added about 10% more of ammonium sulphate and the specific gravity adjusted to 1133. The resulting precipitate is the pseudoglobulin and with it is associated the protecting substance in the blood of the horses immunised against snake venom. This precipitate is collected, pressed and dialysed. To the dialysate are added 1% of sodium chloride, enough sodium carbonate to give a reading of pH 7·6 and an antiseptic. It is then allowed to stand undisturbed until clear and filtered through a Seitz filter. The finished product is a clear fluid with a greenish or at times brownish tinge. Its protein content is below 16% and the viscosity is about six times that of normal saline.

The details of the procedure will be published shortly in the *Indian Journal of Medical Research*.

The serum is made only against the cobra and Russell's viper. It has no effect against the bite of the "Krait" (*Bungarus*) or "phoorsa" (*Echis*). As a great majority of the deaths from snake bites in India, however, occur from the bites of the first two snakes, making the antivenene polyvalent at this stage would interfere seriously with its ultimate potency against these snakes. It is hoped that in the near future it will be possible to adopt better means of immunisation, obtain more potent sera and mix them to make a polyvalent serum.

Obituary.

Dr. A. N. Meldrum, I.E.S.

ANDREW NORMAND MELDRUM died in Edinburgh on the 14th of March 1934, as the result of an accident. He was born on March 19th, 1876, and was educated at the Royal College of Science, London, Aberdeen University and the Victoria University, Manchester. He obtained the A.R.C.Sc. (London) in 1896 and the D.Sc. of Aberdeen in 1904. Before he came to India he was a member of the chemical staff at the University College, Liverpool, and of Aberdeen University.

Dr. Meldrum joined the Indian Education Service in 1912, and was appointed to the Professorship of Chemistry at the M. R. Science Institute of the Gujrat College, Ahmedabad. In 1922 he was transferred to the Royal Institute of Science, Bombay, as Professor of Chemistry, and he was appointed Principal of the Royal Institute of Science, in 1925. He retired on reaching the age limit in 1931.

When Dr. Meldrum came to the Bombay Presidency he first devoted himself to organising the Laboratories of the M. R. Science Institute, and to improving the Science courses of Bombay University. These courses and the methods of teaching science employed throughout the Presidency owe much to him. When the foundation was laid, he turned his attention to training students in the methods of research. Many of those who are now doing research and teaching work in the Presidency were his students. He worked chiefly on the chemistry of chloral compounds, and as his knowledge of chemistry was wide, he also carried out investigations for the Department of Industries on problems of industrial interest, and studied the electrical properties of acids, such as boric acid in solution. Between 1926 and 1931, 22 students obtained the M.Sc. degree by thesis under his guidance.

He did not limit his activities to Bombay, for he served as President of the Chemistry Section of the Indian Science Congress, and he was for a time Editor of the *Journal of the Indian Chemical Society*.

During the years he was in Bombay he took an active part in University affairs, and was a member of the Senate and the Syndicate, and served on a great number of University Committees. In 1930, he was elected Dean of the Faculty of Science. He took a prominent part on the Committee which did the preliminary work, leading to the founding of the new Bombay University Department of Chemical Technology. Dr. Meldrum was nominated by Government as a Trustee of the Prince of Wales Museum of Western India, and as a member of the Provincial Council for Agricultural Research.

Dr. Meldrum left India in 1931 amidst the hearty good wishes of his many friends for a happy retirement, in which he would enjoy a well-earned rest. A Committee was appointed to establish a memorial in his honour, and an annual prize known as the Meldrum Memorial Prize has been founded in the Royal Institute of Science. He settled down in Edinburgh, and devoted himself to these studies in the history of chemistry in which he had always been interested. He was one of the lecturers at the Priestly Celebration of the Chemical Society in 1933. He was peculiarly fitted for studies in historical chemistry, for added to a wide knowledge of science and a scholarly outlook, he possessed, unlike many scientists, a graceful English style.

He was not, however, to enjoy his retirement long. His only son died in 1933. He then decided to move to Berkshire, to be near his daughter, studying at Oxford, and he died while in Edinburgh completing the final preparations for moving. He leaves a widow and two daughters.

In Bombay educational circles he will long be missed. The Royal Institute of Science is much the poorer for his going, but the spirit which he inculcated will always remain. He has left a memory of a brilliant and painstaking teacher, who had a special pride in seeing that the foundations of the subject in the student's mind were well and truly laid, of a pleasant colleague, and of a just but sympathetic administrator. In his capacity as Principal he so bore himself, that all respected him, that most liked him, and that there were none who could deny to him the attributes of firmness, efficiency, and impartiality. Time will not dim his memory in the minds of those who had the pleasure of knowing him and the privilege of working with him.

T. S. W.

A Simple Air-conditioning Chamber for Laboratory Experiments.

By S. N. Kapur and D. Narayanamurti,
Seasoning Section, Forest Research Institute, Dehra Dun.

FOR the carrying out of various investigations on the physical and physico-chemical properties of wood, which are now in progress in this laboratory, it was considered necessary that such experiments should be conducted under controlled conditions of temperature and humidity. The importance of having constant temperature and humidity conditions during the course of an experiment has been recognised in recent years not only in timber physics but also in other branches of research, such as the study of textile fibres, paper pulp, drying of paints, corrosion of metals, etc. Several authors have described methods of controlling temperature in large air thermostats (*vide* Clark, *Hydrogen Ions*, 1925, p. 232; U. R. Evans, *J. Soc. Chem. Ind.*, 1931, **40**, p. 66; and W. H. J. Vernon, *Trans. Farad. Soc.*, 1931, **27**, pp. 241). For controlling the relative humidity of air in a chamber various arrangements have been described,

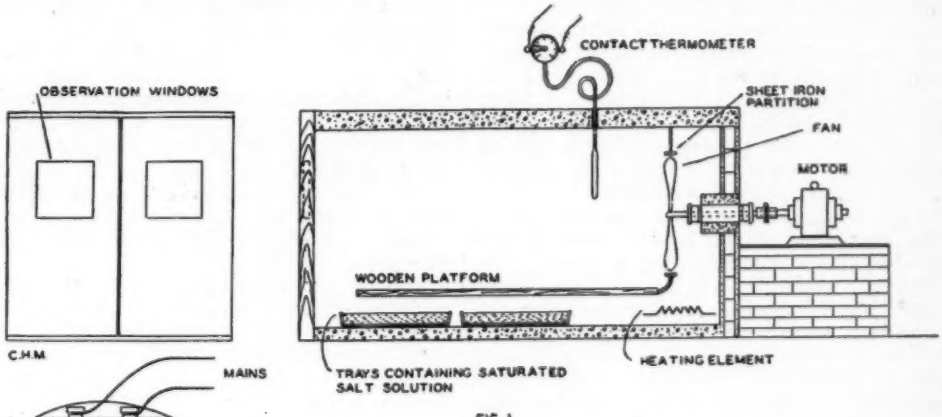


FIG. 1.

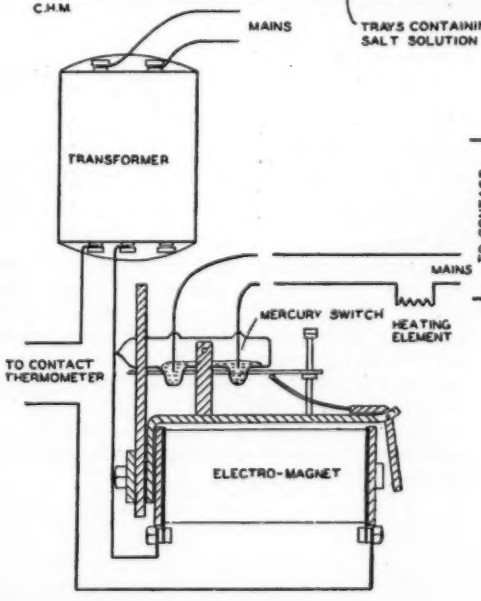


FIG. 2.

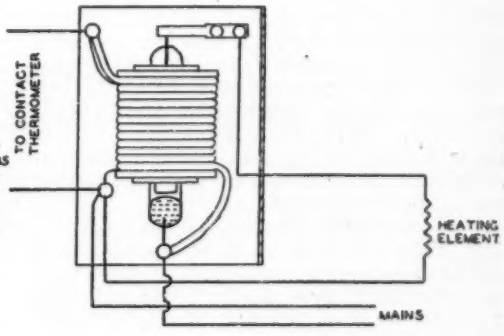


FIG. 3.

that of Vernon and Whitby (*Trans. Farad. Soc.*, 1931, **27**, p. 248) being quite accurate. The method, however, could not be adopted for large-scale experiments on the shrinkage and swelling of wood, where a rapid and uniform circulation of air is desired.

After several preliminary experiments, it was found that the most suitable arrangement was to circulate air by means of a propeller fan inside a closed chamber, control the relative humidity of air by means of saturated salt solutions, and maintain the desired temperature by means of heating elements operated by contact thermometers and mercury switch relays. Fig. 1 shows the constructional details of the cabinet.

The chamber is constructed of brickwork and concrete, as wood was found to warp badly with alterations in humidity from one extreme to the other. It is about 5 ft. long, 3 ft. wide and 3 ft. high. The inner walls of the chamber are plastered with a special water-proof cement and are further painted with a moisture-proof composition to reduce the absorptive capacity of the brickwork. The front is provided with two hinged wooden doors, each having a small glass window, through which the specimens inside can be reached without opening the door, thus avoiding any considerable disturbance of conditions inside the chamber. For air circulation, the blades of a fan are mounted on a shaft running in ball bearings as shown in the sketch and the fan is driven by an electric motor. The fan is placed in the centre of a sheet iron partition at the back of the chamber. A wooden platform divides the chamber into two parts, the lower one having trays containing saturated salt solution for maintaining the desired humidity. At the back of the trays one or more electric heating elements are fitted to supply the heat necessary for maintaining the required temperature.

For temperature control, a distance reading mercury-in-steel thermometer with adjustable electric contacts of the type manufactured by Messrs. Negretti and Zambra, London, is used. Mercury-in-glass contact thermometers manufactured by Messrs. Hermann Juchheim of Ilmenau, Germany, have also been found satisfactory. The latter have the advantage that sparking does not spoil the mercury contacts on account of the presence of an inert gas sealed in the capillary tube. The electrical arrangements adopted are shown in Figs. 2 and 3. Two kinds of circuits have been used, one operating with an Isenthal 'mercury switch type' relay and the other with a 'Vertex' regulator manufactured by Juchheim. The latter type differs from the former and other usual types in its manner of operation, in that the heating circuit is switched on when the magnet coil is excited. It essentially consists of a magnet system and a plunger type mercury switch. The system is connected directly to the mains, when the magnet is excited, which pulls the plunger down, thus switching on the heating circuit. When the proper temperature is attained, the current is closed through the contact thermometer shunting the magnet coil with the result that the heating circuit is switched off.

For control of humidity, as mentioned above, saturated salt solutions are used, which are kept in trays on the floor of the chamber.

The salts which we have used in our work and the relative humidities obtained are given below. For other humidities, a suitable selection can be made from the data given in the *International Critical Tables* (*vide* **1**, p. 67).

Chemicals	Relative humidity at 35° C.
Water only ..	95%
NH_4Cl and KNO_3 ..	70%
$Na_2Cr_2O_7.2H_2O$ ..	52%
$K_2CO_3.2H_2O$ ..	42%
$KC_2H_3O_2$ ..	28%

Chambers as described above have been running in this laboratory for over two years. With reasonable care the largest variation in temperature is not more than 0·1°C. and the humidity variations seldom exceed 3%. Higher sensitivity with regard to temperature control can of course be attained by using a toluene regulator of sufficient capacity and by more efficient lagging of the chamber.

The Leaf, Flower and Fruit Characters of the Santra Orange.

By S. S. Bhat, M.Ag.,

Superintendent, Modibag Gardens, Poona.

DURING the course of several years of work on the Die-back disease of citrus trees in the Bombay Presidency, the writer had opportunities to study the Santra* orange tree in detail. The following observations may be of some interest :—

The leaves of Santra are unifoliate, glabrous, elliptic and accuminate, with a lighter colour on the lower surface than on the upper one. They are leathery in texture and have entire or very slightly serrated margin. Their average length is 6·7 cms. and the average maximum breadth 3·4 cms. The average leaf factor is 2. They contain a large number of small round oil glands. If crushed, they give out a mild and somewhat agreeable characteristic aroma. The petioles are naked, and the wings are very narrow if present. The leaves are alternate or spiral with three to five leaves in a spire.

Internally the leaves are seen to contain a large number of cystolyths of Calcium oxalate. They are larger in size and more in number in the leaves of trees grown in limy soils. Examining sections of leaves of Santra plants grown in the *shadu* soil which contains over 15% of lime, as well as of those grown in compost containing only 0·3% of lime ($CaCO_3$), it was noticed that the cystolyths were larger and eleven in number in the former, and smaller and only nine in number in the latter, in a uniform length of 800μ. On the basis of this indication, both the leaves were analysed and it was found that, on dry matter, leaves from compost contained 7·15% of Calcium oxalate, whereas those from *shadu* soil contained 8·11 per cent. These figures, substantiated by other analytical figures, are interpreted to lead to the conclusion that (1) the orange trees are partial to calcium salts as they gather a large percentage of them (7·15%) even from a proportionately calcium-poor (0·3%) soil, and (2) there is a limit to such absorption as not more than 8·11% is taken in from a highly Calcium-rich (15%) soil.

The flowers of Santra are small, white and very sweet scented. They may be solitary in the axils of well-developed leaves or in small racemes. They are bisexual. Sepels are 5, petals are also 5 and free. Very rarely only four petals are found when one of them is bigger than the others and has a small at its apex. Thus it indicates a double petal. The stamens are sixteen to twenty, the filaments are long or short, variously connate, and compressed at the base. Usually two sets of connate filaments are found—one large with ten to sixteen filaments, and the other small with two to eight filaments. The anthers open after the flower opens. The style is short, medium, or long. When it is short, the stigma is almost close to the ovary, the flower is also smaller than usual, and it drops without setting fruit. When it is medium it is a little more than half the length of the stamens, and in such cases, the fruit may or may not set. The completely developed flower has a long style and the stigma is always in level with the anthers. The stigma comes into receptive condition some time before the flower opens and the anthers are ripe. The ovary is many-celled. The flowers generally open in the evenings and take several hours before they are wide open. The outermost petal opens before the others. To start with a small slit is seen at the apex of a fully developed flower bud; then it takes at least an hour before the free petal opens; then the others follow. Cool breezes hasten the opening of the flowers. The petals and the stamens drop soon after the pollination, but the style persists for some days until the ovary becomes deep green and well established.

The fruit of Santra is deep orange coloured when properly ripe. The rind is smooth and thin. It shrivels and presents prominent folds, when the fruit is kept for some days after harvesting. The cavity is generally absent. When present, it is narrow and small. There may be sometimes a small necklike projection of wavy rind near the stalk. The stalk is medium in thickness. The basin is shallow, broad and round. The size of the fruit is medium, the main axis measuring 7·8 cms., and the maximum diameter, 8·9 cms. The form of the fruit is round and oblate. The rind is full of small pits, with thickly placed oil glands. In ripe fruits, the rind is very thin, being only 2·3 mms. in thickness. When the fruit is ripe, the segments become loose and detached from the rind, with a white woolly material loosely occupying the interspace. In all stages of the development of the fruit, the rind is easily separable from the segments, except during the first two or three months. The number of segments in the fruit varies from 8 to 13. The segments are enclosed in a membraneous cover, which can be easily removed. They form the septa in the fruit which separates the different segments from one another. The core is open with a fairly big hollow, when the fruit is ripe, with the wool thinly placed in fine fibres which are attached crosswise to the walls. The pulp is bright orange in colour. It is very juicy. The juice is delicious, being sweet and well blended with sourness. The small juice sacks are spindle or needle shaped, with their base attached to the septa by thin delicate stalks. The juice sacs melt easily in the mouth and leave practically no rag. The seeds are about twenty per fruit and are irregularly distributed in the different segments. They are also medium in size, and mostly egg-shaped.

The Santra fruit takes about ten months for complete development from the time of flowering. The development of the fruit at various stages shows that in the first few months, the fruit is hard, with its rind closely adhering to the segments inside. The pulp is very acid and becomes more and more juicy after the fourth month. The skin becomes gradually loose from this period. The colour of the fruit begins to change from deep green to yellow and then to orange from the eighth month.

*Santra is *Citrus nobilis*, variety *deliciosa* (Cheema, G. S. and Bhat, S. S., "A study of the citrus varieties of the Bombay Presidency," *Current Science*, February 1934.

Some Physical and Chemical Considerations on Plant Nutrition and Growth.*

By B. Viswa Nath.

IN spite of the large amount of work that is being done all over the world, the subject of plant nutrition continues to be a puzzle. To those who have grown plants in solution, solution *cum* sand, pots and under field conditions and compared the results, the discrepancies and anomalies must be evident. The writer's experience with such crop plants as rice, millets, cotton and sugarcane has set him to think on some chemical and physical aspects of plant metabolism and growth and to enquire how far plant growth can be regarded as a chemical reaction. Pending detailed publication, the salient points of the problem are now briefly mentioned.

Plant growth taken as a whole, is an integration of the plant's response to internal and external factors. Several of these are beyond control and even those that are amenable to control could be done so only imperfectly. Such internal processes as hydrolytic and dehydration changes and the synthetic processes concerned with carbohydrates, fats, proteins and other compounds, have been investigated and found to conform to known physico-chemical laws applicable to chemical reactions which the Chemist studies in the laboratory. When, however, plant growth and metabolism are examined as physico-chemical reactions in the light of modern knowledge some interesting points for discussion present themselves.

Viewed as a chemical reaction, plant growth is one of auto-catalysis. Starting with the germination of seed and its respirative activity, and following the increase in the weight of the plant, it is possible, from well-conducted experiments, to construct sigmoid curves when the results of periodical increases in weights are plotted against time intervals. Analysing the curve, three distinct stages may be differentiated, although it may not be possible to draw exact lines of demarcation. The first is the development period in which the inflow of nutrients occurs; the second is the assimilation period and the third is the period of redistribution of nutrients between the soil and the plant. The growth in the development period, and under conditions of increasing or decreasing magnitude of nutrient factor admits of interpretation in terms of the fundamental law of chemical reaction—the law of mass action—and its important principles, namely, the nature of reaction, the amount of reacting substances, the influence of catalyst on the reaction and, within limits, the temperature at which the reaction proceeds. This holds good generally for plant-growth as a whole in different kinds of substrates.

The understanding of the absorption of nutrients, however, presents difficulties. The absorption of nutrients by plants in soil involves the inter-relationship between soil and plant. It is generally believed that plants absorb nutrients only from solution and that the absorption is primarily concerned with ions. Considerable work was done on ion absorption and on selectivity and antagonism of ions. Several hypotheses were put forward to explain the conflicting results obtained. Recent comparative studies on soil and solution, direct pointed attention to the inadequacy of the existing hypotheses and to the necessity for discussion of several questions on the absorption of nutrients by plants and the mechanism involved in the process.

The selectivity and the differential nature of ion absorption, and the exchange of one ion for another in solution have led to the concept of permeability and as a consequence all theories in regard to permeability assume the existence of a permeable membrane. The nature of the substance that forms the membrane and the question whether permeability can be regarded as a purely physical phenomenon are still under discussion and the available evidence, in so far as plant nutrition is concerned, points to the direction that living membranes should be endowed with "physiological" as well as physical permeability, seeing that permeability alters with the death of the living cell and that such substances like organic and inorganic salts, acids, bases and water can enter into the plant.

Under field conditions with low moisture levels—sometimes even as low as 5 to 10 per cent on the weight of the soil and yet plants keep fresh and green and grow—the position is not similar to that in solution cultures. Under such circumstances it is difficult to explain the intake of nutrients by plants in terms of permeability and ionic hypotheses. As Osterhout points out, distinction appears necessary between permeability and absorption. The reactions occurring inside a plant cell or in the intracellular spaces, may remove ions from the sphere of action and thus enable considerable absorption of nutrients to take place without reference to the magnitude of permeability.

The selective absorption of ions is often sought to be explained by Donnan membrane equilibrium theory. Apart from the difficulties in checking the validity of such an explanation, it is doubtful if the theory can be applied to complex plant systems. That it is so is evident from the work of Briggs and Petrie who consider that in the plant the simple Donnan equation which is applicable to free ions would not hold in plant systems containing ions as undissociated salts of proteins or in a state of physical adsorption. A point deserving notice is that the ionic and permeability hypothesis does not adequately explain the absorption of silica in such large amounts by paddy and sugarcane plants. So also with organic manures applied to the soil. The gaps are too many and too big.

At this stage, one is reminded of the view advanced by Comber a few years ago, that plants can directly absorb the colloids in the soil. He postulates a direct union of the root hairs with soil particles. The root hair and the hydrophilous gel coating around the soil particle intermingle and form one system and enable the direct absorption of colloids. To those who are acquainted with exchange phenomenon in soils the concept of direct ionic exchange in plants with or without the intervention of permeability and membrane theories is but a simple step. Our work at Coimbatore and the experiments of Hans Jenny in America are suggestive in this direction.

* Text of a paper read before the Bangalore Easter Science Congress, 1934.

Evidence is accumulating in several laboratories in India and abroad to show that the physico-chemical laws applicable to plants, growing in solution cultures are not applicable to plants growing in soil and the time may soon come when we may have to apply ourselves to a radical reconsideration of our views on the mechanism concerned with the absorption of nutrients by plants under natural conditions.

Research Notes.

A New Isotope of Hydrogen of Mass 3.

A NEW hydrogen isotope of mass 3·0151 formed by the action of diplons on diplons is reported by M. L. E. Oliphant, P. Harteck, and Lord Rutherford (*Proc. Roy. Soc.*, A, **144**, 692, 1934). They have studied the effects produced when diplons are employed for bombarding targets covered with a thin layer of preparations containing heavy hydrogen. These were ammonium chloride, ammonium sulphate, and orthophosphoric acid, in which the normal hydrogen had been largely replaced by diplogen. In each case enormous numbers of fast singly charged particles were found to be emitted, consisting essentially of two prominent groups of ranges 14·3 and 1·6 cms. respectively. These groups containing equal numbers of particles have been identified, the first as protons, and the second as the nuclei of a new isotope of hydrogen of mass 3·0151. The reaction assumed is

$$_1D^2 + _1D^2 \rightarrow _2He^4 \rightarrow _1H^1 + _1H^3,$$

the mechanism being that as a result of close collision two diplons unite to form a new highly unstable helium nucleus of mass 4·0272, possessing an energy of about 23 million volts in excess over that of the normal helium nucleus of mass 4·0022, and this unstable nucleus then breaks up in a number of ways, one of which is indicated by the above equation. A second mode of disintegration into an isotope of helium of mass three and a neutron according to the equation

$$_1D^2 + _1D^2 \rightarrow _2He^4 \rightarrow _1He^3 + \text{neutron},$$

seems also possible, from among other considerations, the fact that a large number of neutrons are produced in the above experiment. This new isotope of helium of mass 3·0178 has, however, already been indicated in the bombardment experiments on lithium atoms of mass 6, by protons.

M. A. G.

Technique of Sputtering Sensitive Thermocouples.

IN a paper in the April number of the *Review of Scientific Instruments* Louis Harris and Ellis A. Johnson describe a method of construction of thermocouples sensitive to the alternating temperatures of sound waves or to small intensities of intermittent radiation. For both these purposes the thickness of the thermo-elements must be of the order of 10^{-5}cm. Cathodic sputtering offers a very convenient way of obtaining such films. The metal films are sputtered on to thin films of cellulose acetate or cellulose nitrate supported by a mica framework, in an atmosphere of argon. Using proper templates of mica during sputtering alternate strips of bismuth and antimony or bismuth and tellurium are obtained. The ends of the thermo-elements thus obtained are heavily sputtered with gold to which the leads, consisting of fine wires, are soldered. The hot junctions of the thermo-elements are blackened by evaporation of antimony under an air pressure of 0·5 mm. Used in conjunction with a low frequency amplifier even single junction couples of this type should be sensitive to about 2×10^{-10} calories per sq. cm. per sec., while multijunction elements permit the measurement of even lower radiation densities.

S. R.

Ultra-Violet Monochromators.

IN an article in the *Review of Scientific Instruments* (1934, **3**, 149), C. R. Harrison has described some designs for a cheap but effective monochromator for the ultra-violet. The simplest of them consists merely of a spherical concave mirror immersed in a basin of distilled water at an angle of about 30° from the horizontal; this acts as a crude prism somewhat on the principle of the Fery quartz prism, and gives monochromatic though distorted images of a high power horizontal mercury arc used as a source. Its resolving power is less than that considered suitable for a commercial monochromator, but far greater than that expected of a filter. Such an instrument should be useful for many types of biophysical and photo-chemical work.

Further improvements could be made on the above design, such as for reducing the

distortion. It has also been suggested that it should be possible to make large prisms and lenses of ice kept cool at all times by mechanical refrigeration. A few preliminary experiments on figuring ice lenses have already indicated the possibility of making extremely large optical parts at low cost.

Brownian Movement of Rotation.

THE significance of the irregular Brownian movement of translation executed by tiny solid particles has been pointed out long ago in 1905 by Einstein and Smoluchowski as thermal vibrations in the sense of the gas kinetic theory. Now, these particles should also similarly exhibit irregular motions of rotation about their centres of gravity. V. Schmieschek has described an experiment (*Z. Techn. Physik.*, 1934, **15**, 178) which claims to photograph these motions and thus provide further experimental evidence for the gas kinetic theory. The principle of the experiment consists in allowing a very bright small spot of light as from the positive crater of an arc lamp to be reflected from the surface of a tiny silver crystal on to a photographic film. Regular hexagonal crystals of maximum diameter 0·03 mm. were prepared and suspended in water contained in a vessel with plane parallel sides. It will not be possible to observe the tiny irregular rotations of these crystals with an optical system such as the eye or eye + microscope since such rotations will but correspond to a small bundle of light. When, however, the light falls on a matte surface tiny spots of light can be seen (and photographed) to execute zig-zag motions. An amplitude of vibration of 1 mm. was observed on a plate placed at a distance of 20 cm. from the crystal particles. This must correspond approximately to an angle of rotation for the crystal of $8' \times 9'$ and therefore, as the diameter of the crystal was 0·02 mm. to an actual displacement of one edge corresponding to another considered as stationary, of only 0·00005 mm. Specimens of photographs taken are presented.

A New Colour Test for Vitamin A.

THE reputed antimony trichloride test for Vitamin A due to Carr and Price, has at least two drawbacks:—(1) the initial blue colour that is produced is not stable, and therefore unreliable as a basis for the quantitative estimation of the vitamin, and (2) it is not specific for vitamin A as other carotenoids also answer the same colour test. Rosenthal and Erdélyi have by a simple modification of the Carr-Price reaction succeeded in developing a test, characteristic of vitamin A (*Biochem. J.*, 1934, **28**, 41). The method consists in using 0·5 per cent. freshly prepared solution of catechol in chloroform, in addition to the usual Carr-Price reagent. The mixture containing catechol, antimony trichloride and the vitamin A containing substance is immediately transferred to a water bath at 60°C. and warmed for one to two minutes. The blue colour first produced changes over to an intense violet red, which is more stable than the blue of the Carr-Price reaction. Carotenoids do not give this reaction. The intensity of the violet-red colour is proportional to the concentration of vitamin A and the reaction can therefore be employed for the quantitative colorimetric estimation of the vitamin using a 0·01 per cent. solution of potassium permanganate for comparison.

B. N. S.

The Separation of the Enzymes and Toxic Principles of the venom of *Crotalus adamanteus*.

RATTLE snake venom contains a proteinase and a cephalinase, two enzymes which are responsible for its anti-coagulant action on blood. Their separation from each other has for the first time been accomplished by Dunn (*J. Pharmacology and Exp. Med.*, 1934, **50**, 393) who has employed two distinct methods for the purpose. Fractional precipitation of the venom by subjecting a solution of the venom (in 1 per cent. sodium chloride) of pH 5·2 to a temperature of 85°C. removes the proteinase completely, at the same time causing little decrease in the cephalinase activity of the filtrate. A 20 per cent. urea extract of the coagulum, after dialysis, exhibits a slight proteoclastic activity. Cephalinase can be completely adsorbed by a somewhat aged preparation of Aluminium Hydroxide C. The author has made the interesting observation that whereas freshly prepared Aluminium Hydroxide C adsorbed both the enzymes quantitatively, the same preparation eight months old adsorbed only the cephalinase leaving the major portion of the proteinase in solution. The adsorbent twelve months after preparation failed to adsorb either of the enzymes. Aluminium Hydroxide A adsorbs both the enzymes,

which can be eluted from the adsorption by a phosphate buffer solution (pH 6·9) to which 25 per cent. of its volume of glycerol has been added.

——— B. N. S.

The Movement of Food Materials in the Cotton Plant.

THE growth of the cotton plant is a problem of immediate concern to the Indian agriculturist, as this country is the second largest in cotton production. Any research or investigation relating primarily to the development of this species is, therefore, of the utmost importance. Mason and Philis of the Cotton Research Station, Trinidad, have formulated tentatively their views on the translocation of food materials in this plant (*Emp. Cotton Grow. Review*, XI, 121, 1934). During the vegetative phase the mineral nutrients absorbed by the roots are transferred to the leaves along with the transpiration current. The roots receive carbohydrates from the foliage for their growth and development. Thus the leaves are not only the store-house of sugars but also of the bulk of the mineral salts and they further act as the distribution centre of these products to other parts of the plant. According to the authors, during the vegetative phase, storage of inorganic materials takes place in the roots, stems and leaves. In the reproductive stage the manufactured food materials are translocated to the developing bolls. During this period, absorption of minerals through roots is inhibited, the plant in consequence ceasing to function in course of time.

The mechanism of the translocation of food materials, chiefly organic, is rather interesting. The sugars in the leaves first travel to the fine veins, against a gradient and thence are translocated through the sieve tubes of the phloem region, which extends to the bolls and traverses the bark of leaf stalks, etc. Here the direction of translocation is not unidirectional. The more significant feature about the movement of sugars in the sieve tubes is the rapidity of transportation which is thousands of times greater than the movement due to physical diffusion, the mechanism of which is still obscure.

The distribution of mineral elements from the leaf is also through the phloem, where the majority of them are mobile, but calcium and iron appear immobile. In the cotton plant, calcium does not appear to be present in the sieve tubes, while chlorine is largely available in them. It is useful to point out here that accurate micro-chemical analyses of the saps of the several tissues only can help in the examination of these materials. By their ringing tests, the authors have produced evidence of leakage of potassium, magnesium and chlorine into the woody tissues, and that these do not accumulate in the portion above the ring.

Flowback of minerals during the later stages of development is the view of physiologists and the same is gaining ground day by day. The authors have further shown that such flowback is evident from the corolla of flowers when these change colour from yellow to red.

The views put forth above are only tentative and call for critical examination at the hands of physiologists. It seems necessary to add that methods of micro and ultra-micro nature need to be evolved for testing saps and tissues of comparatively small dimensions.

——— V. I.

Coffee and Human Efficiency.

IT is not uncommon to find that coffee is either landed or berated vigorously, in its relation to human efficiency. The subject is so old and in spite of the controversy, its consumption is only on the increase. The scientific aspect of coffee in the diet has not been lost sight of by investigators. Unlike other researches which relate to the administration of coffee and beverages from coffee on pathological conditions, R. C. Cheney (*J. Amer. Pharm. Assoc.*, 23, 143, 1934) has devoted his attention to the physiological effect of coffee on human subjects of normal health. Opinion is generally divided as to the efficacy of coffee in improving muscular function, but in the present instance, evidence is adduced of positive effects in that direction. Among other things, the following factors were studied: blood pressure variations, respiration and time for recovery after fatigue. The experiments were carried out under identical conditions, with the treatment either with hot water, black coffee or caffeine in hot water, as the variable. Prior to the fatigue test the several drinks mentioned above were administered and the actual test consisted in lifting weights every ten seconds to complete fatigue. It was found that the work done was least in non-treated or hot water treated days and most in caffeine days, with that on the coffee day

lying in between the two. As regards blood pressure, no variations were noticed, while an increased respiratory activity in the coffee treatment indicated a greater oxygen consumption. This latter activity is related to intercranial pressure, decreasing the rate of cerebrospiral fluid secretion. Evidence has already been presented on the increased salivary secretions in volume per unit volume as a result of coffee drinking. Professor Hollingworth has reported a clearly distinguishable stimulation of the mind due to coffee. Thus there is sufficient evidence to say that coffee invigorates the brain and other parts of the central nervous system. Caffeine in coffee is less effective —probably due to the presence of other substances in the same—than separately. Fatigue is delayed.

But it must not be assumed from this that coffee can replace other foods in the normal course. Although its stimulating action persists for a considerable length of time after consumption, it is at best an aid to human efficiency and can never be a substitute for body fuel. The increased efficiency is perhaps due to the simultaneous invigoration of both the circulation of blood and general respiratory metabolism. It is therefore advantageous to avail of this aid during moments of depression and fatigue.

V. I.

Polymorphic Phenomena and Crystal Structure.

AN interesting paper on this subject by Tom F. W. Barth appears in the April issue of the *American Journal of Science* (**XXVII**, Fifth Series, No. 160). The author starts with the following definition of polymorphism—"Polymorphism includes every possible difference encountered in the crystalline lattice of a substance of constant chemical composition, excepting homogeneous deformations," and then proceeds to classify the several polymorphic changes occurring in crystals into three groups:—(1) A complete alteration of the space-lattice with the formation of a new type structure. Since the type of structure is changed, this case could be referred to as polytypy. (2) A distinct change in the syngony (*i.e.*, geometrical symmetry) of the space-lattice although the atomic arrangement, density, or cleavage properties are so slightly affected that the type of structure is preserved and merely a new variant of structure is formed. Such differences in the syngony properties could be referred to as polysyngony. (3) A change in the physical properties without any change of the syngony of the lattice. A new variant of structure is thereby formed but the type is of course preserved. Such properties of a crystal could be referred to as polytropy. In the latter part of the paper the polymorphism of potash felspar has been specially treated. Notwithstanding the fact that apparently monoclinic alkali felspars composed of submicroscopically twinned triclinic units do occur in nature, it can be shown that potash felspar is trimorphous.

L. R. RAU.

Micro-Hardness of Minerals.

IN a recent number of the *American Mineralogist* (**19**, No. 4, April 1934), H. C. Hodge and J. H. McKay have given a brief account of their determination of what they call the 'micro-hardness' of minerals with the help of a special instrument called the microcharacter. The minerals comprising the Mohs scale of hardness have been specially selected for investigation and the data obtained have been tabulated as follows:

Mohs scale	Width of cut in Microns	Micro-hardness
1. Talc	93·6	1
2. Selenite	90·3	11
3. Calcite	8·8	129
4. Fluorite	8·4	143
5. Apatite	5·5	517
6. Orthoclase	3·2	975
7. Quartz	1·9	2700
8. Topaz	1·7	3420
9. Corundum (Var. Sapphire)	1·4	5300

The authors suggest that the microcharacter may be applied to a more complete study of the hardness of minerals, particularly in regard to (1) the hardness-changes produced by changes in composition; (2) the hardness-changes produced in variously oriented crystals in an aggregate; or (3) the study of hardness with a view to the identification of the components of aggregates.

L. R. RAU.

Science News.

Birthday Honours:—The names of the following distinguished scientists in India are found among the recipients of the awards:—

Knighthood.—Dr. Upendranath Brahmachari, Calcutta.

C.I.E.—Lt.-Col. H. H. King, I.M.S., Director, King Institute, Guindy, Madras; Dr. W. McRae, Director and Mycologist, Imperial Institute of Agricultural Research, Pusa.

Rao Sahib.—Mr. V. Muthuswamy Iyer, Lecturer in Agricultural College, Coimbatore.

Rai Sahib.—Babu Jogindranath Gosh, Professor of Chemistry, Greer Bhumihar Brahman College, Muzaffurpur.

* * *

Rao Bahadur B. Viswanath, now Agricultural Chemist to the Government of Madras, has been appointed Imperial Agricultural Chemist. He will shortly leave Coimbatore to take up his duties at the Pusa Research Institute. Pending permanent arrangements, Mr. P. V. Ramiah will act as Agricultural Chemist to the Government of Madras.

Dr. Hem Singh Pruthi, of the Zoological Survey of India, has been appointed Imperial Agricultural Entomologist.

The Imperial Agricultural Research Station, now located at Pusa, will be transferred to a suitable site in the vicinity of Delhi. It may be recalled that the buildings of the Pusa Institute suffered heavy damage during the last earthquake. It is estimated that the entire scheme for the transference will involve an expenditure of 30-40 lakhs of rupees.

* * *

Prof. F. N. Mowdawalla, who recently resigned his appointment as Professor of Electrical Technology in the Indian Institute of Science, Bangalore, has, we understand, been appointed Principal and Professor of Electrical Engineering of the University College of Engineering, Bangalore.

* * *

Agricultural Research in Bengal, 1932-33:—During the year, five schemes of research financed by the Imperial Council of Agricultural Research were in operation. From the financial assistance received by the Imperial Council and the Empire Marketing Board, a comprehensive scheme of research on rice was started and it is expected that as a result improved strains of trade rice will soon be introduced in Western Bengal and the export of this class of rice will be stimulated. The other schemes sanctioned by the Imperial Council include Fruit Research Work at Krishnagar and investigations into the costs of cane cultivation and rotation of crops in certain districts of Bengal.

The cane-crushing mill, designed by the Agricultural Engineer, was further improved and it has now been possible to deal with a maximum of 44 maunds of cane per hour with 74 per cent. extraction.

Owing to continued trade depression and competition from outside, the sericulture industry in Bengal was in a condition of stress and the situation was aggravated by unfavourable weather conditions not only for the growth of mulberry but also for the progress of silkworms. Demonstrations and propaganda were carried out as usual and preventive measures for dealing with the outbreak of disease among silkworms were undertaken by the staff.

* * *

Provincial Economic Conference, 1934:—The grave problems that have arisen as a result of depression in the prices and demand for primary commodities of the country and their effect on the agricultural classes calling for immediate action were discussed at a joint Conference consisting of provincial representatives held at Delhi from the 3rd to 6th April. Several subjects of vital importance to the country such as agricultural indebtedness, marketing of agricultural products, crop-planning, industrial research, economic surveys and statistics, etc., came up for discussion and important decisions were arrived at.

On the subject of marketing agricultural produce, the approved programme includes the appointment of central and provincial marketing surveys, the appointment of special committees for staple crops starting with oil seeds and tobacco; and work on grade standards under the direction of Imperial Council of Agricultural Research. In order to study problems involved in the preparation of dairy products for different markets, a Dairy Industry Institute which will include a laboratory for carrying out research on the physical and chemical properties of Indian milk and its reaction to the various forms of processing and transport under Indian conditions, will be attached to the Imperial Institute of Animal Husbandry and Dairying at Bangalore.

A conference of provincial Directors of Agriculture and land revenue officers will be convened at an early date in order to discuss programmes for the regulation of production in adjustment to demand.

The Government of India have also decided to establish a Central Intelligence Bureau whose functions will include collecting and disseminating industrial intelligence, assisting the organisation of industrial exhibitions in India, publishing bulletins relating to industrial research, assisting industrialists by giving advice and making suggestions as to the directions in which research should be undertaken, etc. The Bureau will be attached to the Indian Stores Department. The Government of India also propose to disburse grants for the promotion of industrial research in specified subjects whenever necessary. They have decided to give a grant for sericultural research and another grant for the encouragement of the hand-loom industry. Further information regarding the conference may be obtained from the *India Trade Journal* (1934, **CXIII**, 552-556).

* * *

Empire Forestry Association:—The annual meeting of the Association was held during the last week of May, at the South Africa House, London. In the course of his speech Sir Bhupendranath Mitra, High Commissioner for India, said that India had the distinction of being the first unit in the Empire to develop scientific forestry; the forest service, as a trained service, was started in India as early as 1856 and since then the Government of India have placed the conservation of forests in the forefront of its policy. It may be pointed out that next to Canada, India is the

largest forestry country in the world with an area of about 300,000 sq. miles under timber. It is the principal source of fine quality timber in the Empire.

Sir Bhupendranath Mitra (High Commissioner for India), Lord Stonehaven, Mr. J. G. McLaven (Official Secretary for Australia), Mr. W. McAdam (Acting Agent-General for British Columbia) and Mr. J. D. Smith were elected to the Governing Council of the Association.

* * *

Cotton Research in the Punjab:—The Indian Central Cotton Committee has undertaken a scheme for experiments on defibrating and delinting cotton. The seed of the long staple cotton grown in the Punjab is difficult to dispose of as they are fuzzy, and are supposed to be unsuitable as cattle feed. Consequently they fetch a very low price on the market. Comparative feeding trials conducted by the Agricultural Chimist at Lyallpur have shown that the fuzzy seed produced no harmful effects at all and cattle fed on those seeds thrived just as well as those fed on naked-seeded cottons.

* * *

Rockefeller Institute of Public Health for Japan:—Arrangements have been made for establishing an Institute of Public Health at Tokyo, attached to the Imperial University. It is proposed to build two hospitals one at Kyobashi-Ku, Tokyo, for the training of students and another at Tokorozawa. It is expected that the construction of the proposed buildings will take two years.

* * *

Manufacture of Steel in Mysore:—The Board of Management of the Mysore Iron Works, Bhadravati, have recommended to the Government the advisability of undertaking steel manufacture. The concern at present blasts only pig iron suitable for foundry purposes and according to the opinion of competent experts the addition of a steel plant will help to produce readily saleable articles and go a long way in stabilising the position of the Works. It is hoped that the Government will give effect to the recommendation of the Board.

* * *

Bee-rearing in Mysore:—The Department of Agriculture in Mysore is now taking a keen interest in the honey industry and is carrying on propaganda in favour of bee-keeping industry as a subsidiary occupation for farmers, particularly in the western districts of the State enjoying very favourable natural advantages. The State is now importing honey from Europe, Australia and New Zealand and encouragement of an indigenous industry, now in a primitive condition, is expected to make the State self-sufficient.

* * *

Fresh earthquake tremors of slight intensity are being reported in the Himalayan regions which experienced a disastrous earthquake on the 15th January last. Raxaul, Dacca, Agartala and Sylhet reported earthquake shocks on the 2nd June and a few villages in Nawabshaw district are reported to have felt shocks on the 4th June.

A terrible tornado swept over Sylhet on the 13th April, resulting in severe losses to life and property. Thousands of houses were blown out and several villages entirely wiped off. Jaldhup area alone has reported fourteen deaths.

* * *

Professor Wadia of the Wilson College, Bombay, and President of the Indian Inter-University Board, will shortly sail for America on a lecture tour. The Professor's object is stated to be "to interpret the soul of India for the benefit of Americans and to promote a better understanding between the peoples of the two countries". He will address several universities and associations all over the country, mainly on cultural subjects.

* * *

Spontaneous Ignition of Jute:—The causes of frequent occurrence of fires in jute cargoes destined for American ports, is now being investigated by the United States Bureau of Standards. As a first step the susceptibility of jute to spontaneous heating from microbial growth and from vegetable and animal oils spread over the jute was studied. The results have shown that self-heating resulting in ignition can be obtained consistently with linseed oil and menhaden oil on jute starting with spread initial temperatures in the range of 36°—50°. The factors favouring heating and ignition include optimum percentage of oil to fibre and thorough coating of the fibre with oil. The density and size of the sample were also found important, as well as the surrounding temperature and air supply.

* * *

All-Glass Buchner Funnels:—Amongst the apparatus recently introduced, the All-Glass Buchner Funnel is perhaps the most useful to the chemist. With the porcelain Buchner it was not possible to ascertain whether the surface below the filter plate was clean. Further the small size of the holes in the filter plate did not permit rapid filtration. These and other disadvantages have now been overcome in the new "All-Glass" Buchner Funnel, available in five different sizes. This new innovation cannot fail to commend itself to the routine as well as the research Chemist.

* * *

Reagents for Spot Tests:—Messrs. The British Drug House, Ltd., have recently put on market all the organic reagents useful for detecting and estimating small quantities of metals and other inorganic substances. The reactions can be carried out in a micro test tube, on a white tile with depressions for drops, on filter paper impregnated with the reagent and dried or on microscopic slides.

* * *

The International Congress of Anthropological and Ethnological Sciences is to be held in London at the end of July and H. R. H. the Duke of York will welcome the scientists from all parts of the world who are expected to attend the session. Dr. B. S. Guha, Anthropologist, Indian Museum, Calcutta, has been officially invited to attend the function and this honour is a fitting tribute to his important publications on the scientific study of the Indian races in their applications to their social and economic development, their religious and superstitious practices and their customs and manners. We have pleasure in congratulating Dr. Guha on the distinction conferred upon him and we have no doubt that his contributions will bring credit to India.

* * *

We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 133, Nos. 3363 to 3366.
"The Chemical Age," Vol. 30, Nos. 772 to 775.
"Canadian Journal of Research," Vol. 10, No. 4.
"The Journal of Chemical Physics," Vol. 2, Nos. 3 and 4.
"Berichte der Deutschen Chemischen Gesellschaft," Vol. 67, No. 4.
"Natural History," Vol. 34, No. 3.
"Journal of Agricultural Research," Vol. 48, Nos. 3 and 4.
"Experiment Station Record," Vol. 70, No. 3.
"American Journal of Botany," Vol. 21, No. 4.
"The Review of Scientific Instruments," Vol. 5, No. 4.
"The Mathematics Student," Vol. 1, No. 5 and Supplement to Vol. 1.
"Scientific Indian," Vol. 11, No. 65.
"Indian Forester," Vol. 60, Nos. 4 and 5.
"Medico-Surgical Suggestions," Vol. 4, No. 4.
"Forschungen und Fortschritte," Jahrgang, 10, Nos. 12 to 14.
"Journal of Agriculture and Livestock in India," Vol. 4, Part II.
"The Indian Journal of Veterinary Science and Animal Husbandry," Vol. 4, Part I.
"Indian Forest Records," Bulletin No. 82 (Sylvicultural Series), Vol. 19, Part IX—Entomological Investigations on the Spike Disease of Sandal (19)—On the Life-History and Morphology of *Petalocephala nigrilinea* (Jassidæ Homopt).
"The Indian Trade Journal," Vol. CXIII, Nos. 1454 to 1458. Department of Commercial Intelligence and Statistics, India—Monthly statistics of the production of certain selected industries of India, February 1934, No. 11 of 1933-34.
"Actualites Scientifiques et Industrielles," Nos. 89 to 93 and Nos. 130 to 132.
16th Annual Report of the National Research Council, Canada.
"Records of the Indian Museum," Vol. 36, pp. 123 to 138, Part I,—Worship and Propitiation of Wild Animals at Uttarbhag.

Reviews.

A BIBLIOGRAPHY OF SIR JAMES GEORGE FRAZER, O. M. By Theodore Besterman. (Macmillan & Co., Ltd., xxi + 100 pp.) Price 12*s*. 6*d*. nett.

It was indeed a very happy idea of the many friends and admirers of Sir James George Frazer to have thought of publishing a beautiful Bibliography of his works as an expression of their regard and esteem on the occasion of his celebrating the 80th anniversary of his birth. With the kind co-operation of several prominent men and public institutions with whom Sir J. G. Frazer was associated in the course of his work, Theodore Besterman has, by his diligence, patience and skill, been able to give us a lucid Bibliography of the numerous published writings of this great worker in the field of social anthropology; and there is no doubt that this valuable reference book will ever be a source of inspiration and guidance to other workers in this field. A beautiful recent photograph of Sir James Frazer adorns the book as a frontispiece.

L. RAMA RAO.

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ELECTRICAL ENGINEERING PRACTICE. By J. W. Meares and R. E. Neale. Vol. III, Fourth Edition, 1933. (Chapman & Hall.) 30*s*. nett.

Since the announcement by the authors some time back of their intention to bring out an additional volume of this very useful book, the electrical engineering profession has been looking forward to its publication. The volume now published fulfils the promise held out by the previous volumes and the authors are to be congratulated on the result of their labour. While there are excellent books dealing with the applications of electricity to individual classes of work, need has always been felt for a book covering the entire field of utilisation of electricity for diverse purposes, and the want has been very well filled by this new publication. As in the previous volumes the authors have aimed at making it practical and have with that object inserted a large number of tables containing very useful technical and cost data. Moreover, separate chapters on specification, testing and law have been included at the end of the book. While it should prove of great use to the engineer, it should also be very useful to advanced students as a text-book for the industrial applications of electricity.

Most of the matter in this volume is new and what little has already appeared in the previous volumes has been thoroughly revised and re-written. The book is well written, complete and up-to-date, and should find a place on the book shelf of many engineers. It is written for the purpose of meeting the needs of a wide circle of readers and fulfils the purpose satisfactorily. We whole-heartedly recommend it as a useful addition to the library not only of electrical engineers but also of

consulting engineers specialising in other branches of engineering.

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A TEXT-BOOK OF INORGANIC CHEMISTRY FOR UNIVERSITY STUDENTS. By J. R. Partington, M.B.E., D.Sc. (Fourth Edition, 1933, 1062 pp.) Price 15*s*. nett.

As with the older editions the fourth edition has kept pace with the growing development of the subject both in the theoretical and experimental side. The main alterations, as the author states in the preface, are the transfer of the section on Werner's theory from the end of the last chapter to the more fitting position in Chapter XXV where the discussion has been amplified by the introduction of topics like *chelate* and *dentate* groups and Electronic Theory of Co-ordination Compounds, references to the modern topics like heavy hydrogen isotope, neutron, etc., a general discussion on the hydride of elements and a revision of the section on active Nitrogen. The most interesting feature from the standpoint of the student of modern inorganic chemistry has been the application of the electronic theory of valency to the elucidation of the structure of compounds. Quite a number of the electronic formulæ of compounds has been introduced in place of the graphic formulæ and this is really a very happy departure from the older method of representing the structure of compounds. A table of the electronic structures of the rare earth elements has also been included.

Much attention has been paid in the book to the treatment of various physico-chemical principles, which are very necessary for an easy assimilation and rational understanding of the hard facts of descriptive chemistry.

There is also a collection of typical questions and problems at the end of the book, most of them being selected from the question papers of the British and Indian Universities. The fourth edition on the whole is a very good production and is very valuable as a text-book for the B.Sc. and B.Sc. Honours students of all Indian Universities. In fact the new edition will be welcomed with great pleasure by all students of chemistry.

M. SESHAIYENGAR.

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THE BEHAVIOUR OF ANIMALS: An Introduction to Its Study. By E. S. Russell, D.Sc., F.L.S. (Edward Arnold & Co., London. 180 pp. 1934.) Price 10*s*. 6*d*. nett.

Psychology has developed a new department of study devoted to the investigation of behaviour; and the habits of animals, especially those of gregarious animals, hold an irresistible attraction. The main reason of this fascination is that in the unforgotten depths of our consciousness, there are glimmerings of animal instincts which find an apposite expression in the life activities of the lower organisms and when we come to the more advanced creatures like the Anthropoid Apes, the similarities of behaviour become deeper and more numerous. All works on Natural History are popular and the work of Russell maintains the high traditional interest.

The Mechanistic School of biologists who try to reduce the life activities of animals to the forces of physical and chemical laws of interactions, fail to appreciate the value of the study of the animal in its wholeness and the mechanistic interpretation of the behaviour of animals fails to provide an adequate explanation for spontaneity, co-operation, emotional expressions and herd instincts of animals. The book provides the technical readers with a concise and authoritative information on the most fascinating subject and the general reader will find in it perennial interest. If such a reader were occasionally to find instances recorded in the book not conforming to his own observations, it must be borne in mind that the behaviour of animals under induced experimental conditions, in confined and strange situations, in the menageries and cages where they are exposed every day to human intervention, differ widely from that which they exhibit in their natural homes and haunts and in an atmosphere of their native freedom and seclusion. Very often most extravagant inferences and untenable general conclusions are attempted to be deduced from observations made on domestic animals which through long association with man and his environment, have become as sophisticated as their masters. The book sufficiently safeguards against all fallacies and makes clear the general principles on which the observations should be interpreted. We have read the book with delight and in our judgment it is an interesting chapter in scientific romance.

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MIMICRY. By G. D. Hale Carpenter, M.B.E., D.M., and E. B. Ford, M.A., B.Sc. (Methuen & Co. Ltd., 36, Essex Street, London, W. C. 1933. vii+124 pp.) Price 3*s*. 6*d*. nett.

This little book maintains the high standard which distinguishes the other monographs on biological subjects published by Methuen & Co., and the authors have achieved the difficult task of presenting within a short compass an authoritative exposition, free from technical terms, of a really difficult branch of biological studies. The phenomenon of mimicry is not confined to any group of animals but like joy in widest commonalty spread. The study of mimicry cannot be studied as an isolated fact, but is part of the wider phenomena of colouration and habit. The book, however, deals with the several aspects of mimicry as exemplified by the arthropods especially the groups of insects and spiders and omits reference to the less well understood cases of mimicry among the vertebrated animals.

The theory of mimicry is based on solid foundations and the causes of mimetic resemblance are the very causes of evolution also. Therefore the principle of Natural Selection provides a satisfactory explanation not only of the origin and significance of the general facts of colouration, but also of its special branch of schematic resemblances. The opening sentence which defines the phenomenon of mimicry, "the term mimicry implies the conscious assumption by one individual for his own purposes, of characters peculiar to other," would read better and perhaps would be correct without the word "conscious". The definition might seem to imply that the power of assuming resemblances is within the knowledge and under the volition of the animals concerned. They are no more responsible for their external appearances than for the possession of a complete set of internal organs. Nature imposes both on the animals perhaps, in spite of themselves and it is here that the whole animate world is completely under the dominating influence of some Power in Nature which they can neither compel nor control.

The subject of colouration of animals either from the standpoint of biological or physical sciences is fascinating to a degree and in the whole field of natural history, there is hardly any branch of knowledge more arresting than mimicry and behaviour induced by the adaptive modification of external features. The great merit of the book is that while it presents a complete and up-to-date information on the subject, it excites the curiosity of the reader to pursue his studies in the field and extend his knowledge by personal observation. Every chapter makes delightful reading and the serious student of biology and even the casual reader will find in this book great pleasure and profit. The diffusion of a correct knowledge of the biological theories and facts among a wider circle of readers has become an increasing necessity and books of the type of monographs, which Methuen & Co., have produced, serve a great educational purpose.

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CLASSIFIED CATALOGUE CODE. By S. R. Ranganathan. (Published by the Madras Library Association, pp. 296.) Price 10*s*. 6*d*.

The Classified Catalogue Code by Mr. S. R. Ranganathan is the fourth of a useful series of publications of the Madras Library Association. The rules for the indexing of books and periodicals have been dealt with in detail. Hints have also been given for dealing with Hindu, Muslim and other names, which will be very useful to librarians, especially in India. The Code contains also a scholarly note on Authorial Polyonymy and Homonymy in Sanskrit literature by Mahamahopadhyaya Vidyavachaspati S. Kuppaswami Sastriar, M.A., I.E.S., Professor of Sanskrit and Comparative Philology, Presidency College, Madras. A transliteration table for Sanskrit and Dravidian languages has also been introduced, which the author would have done well to use in the case of many entries in the Code. There are also a few mistakes and printer's devils in the book, such as Granta for Grantha (pp. 26 and 27), amudātta for anudātta (p. 28), Sarvapalli for Sarvepalli (p. 66), New for Neue (p. 273), which we hope will be corrected in the next edition.

K. A.

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VOCATIONAL EDUCATION IN MYSORE. By Dr. K. N. Kini. (Published by the Bangalore Press, pp. 205.) Price Rs. 2.

Plato laid down a fundamental principle of education when he asserted that it was the business of education to discover what each person is good for and to train him accordingly. To this we might add that the key to happiness is to find out what one is fitted to do in life and to secure an opportunity to do it. Speaking generally the purpose of Dr. Kini is merely to show the way to achieve this happiness in a practical way and to avoid the tragedy caused by people drifting into uncongenial callings by

force of circumstances. Dr. Kini has done this task most admirably. The intimate knowledge of facts which his previous experience in Mysore had given him, combined with a careful appraisal of conditions obtaining in the West has made it possible for Dr. Kini not only to present the problem of Vocational education as related to the State of Mysore but also to offer some practical suggestions which challenge the attention of those interested in the economic and educational rebuilding of our State. I have read his book with great interest and profit and I commend it most unreservedly to all students of education and more especially to those in authority in our State without whose patronage and generosity no forward step in Vocational education can be taken.

T. N. J.

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DIP AND STRIKE PROBLEMS. By Kenneth W. Earle, D.SC., F.G.S. (Thomas Murby & Co., London. x+126 pp.) Price 12*s.* 6*d.* nett.

Of the nine chapters in this book, the first five deal with the different aspects relating to the calculation of dip, strike, and thickness of strata, and the next three are devoted to the solution of problems involving faults and their effects on synclines and anticlines. The last chapter gives a brief account of the various mechanical devices like the 'Dip diagram', 'Oldham's graticule', 'Harker's protractor', etc. At the end there is a Glossary of structural terms and a useful Bibliography for the advanced student.

This book is obviously an expression of the growing tendency among some geologists to introduce strictly mathematical methods in the solution of problems in structural geology. Opinion has been divided on the desirability of such a tendency, and serious doubts have been expressed as to how far such methods will really enable the field geologist to tackle his problems in a more efficient manner and with more reliable results than before; and one is easily inclined to agree with the author of this book when he says "that any mathematical calculation connected with geological strata must be *per se* only approximate in accuracy."

Despite the realisation of this fact on the part of the author, there is no doubt that while writing this book he is still carried away by his enthusiasm to introduce mathematical methods in the solution of problems in structural geology; and the book under review bears ample evidence of the fact that he is very much enamoured of such 'mathematical' treatment and delights in straightaway reducing all problems in structural geology to so many exercises in geometry and trigonometry.

L. RAMA RAO.

Errata.

Page 435—Magnifications.

Fig. I	..	..	*for*	"×79"	..	*read*	"×32"
Fig. II	..	..	*for*	"×79"	..	*read*	"×32"
Fig. III	..	..	*for*	"×75"	..	*read*	"×31"
Fig. IV	..	..	*for*	"×75"	..	*read*	"×31"
Fig. V	..	..	*for*	"×30"	..	*read*	"×12"
Fig. VI	..	..	*for*	"×20"	..	*read*	"× 7"
Fig. VII	..	..	*for*	"×20"	..	*read*	"× 8"

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SUPPLEMENT TO "CURRENT SCIENCE".

Reviews.

THE CONTINENT OF ASIA. By Lionel W. Lyde. (Macmillan & Co., Ltd., St. Martin's Street, London. xxii+747 pp. 1933.) Price 16s. nett.

It is difficult to say which is more difficult, either to write a book of this magnitude and importance or to read it. Prof. Lyde has a continental mind. He took five years to get a mental picture of Europe, then set to work on South America, North America, Africa in succession and finally spent twelve years to visualise before his mind the picture of Asia. His mental picture is "easy, simple and true" and the weight of information is no burden on his memory. If an author of the mental calibre of Lyde's requires twelve years of hard study and investigation to get a complete mastery over the details of a single continent, what about the immature students sitting for the University examinations being required to exhibit an equally intimate and detailed knowledge of *all* the continents of the world at the end of two or three years' study? Here is a clear illustration of the fundamental principle of education, *viz.*, that knowledge implies an evolutionary process extended over a prolonged period of time and cannot be compressed by the University hydraulic machinery.

The book is certainly classic in substance and form. The style is literary and engaging. The illustrations are excellent and adequate. The arrangement of topics is easy and logical. The information is bewildering in the mass, and satisfies even a gargantuan appetite. To be able to write a fascinating book of this description on the biggest continent which presents the most complex varieties of physical features, climatic conditions, natural products and ethnic differences, implies a mental equipment of the highest order. We have nothing but praise for the author and his great work.

The book is divided into two parts. The first part which deals with the physical relations of the different geographical units of Asia with one another and of the whole continent with the globe together with the general description of its orography, almost impinges on the domain of Geology. The chapters on "Climate" form a brilliant essay on meteorological studies which are considered under three fundamental factors, *viz.*, size and distribution of land and water areas, the relation of area to the latitude and highland core, which rises steadily in latitude from the South-West to North-East of the continent between the Ægean Sea and Bering Strait. The problem of the climate of this vast land mass which is nearly one-third of earth's surface, must be a world problem, the different aspects of which are marshalled and presented in a cogent and assimilable form. The principles and factors involved in climatological studies are scientific and therefore the general laws and their applications naturally appeal to minds possessing even a moderate scientific training. The chapters on the flora and fauna discuss the problem of their origin, environment, distribution and endemic forms in a manner that they would form excellent sections of works on Botany and Zoology. The next chapter on "Man" is a condensed summary of our ethnological and anthropological knowledge of the diverse races inhabiting Asia, with due emphasis on the human and political note of all the amazing differentiations. The first part concludes with a brilliant dissertation on Geographic "Controls" under which most of the facts and factors dealt with in the previous chapters are reviewed. The word "Control" need not imply determinist causation, but really connotes the tendency of certain geographical conditions to evoke or frustrate human actions and reactions: the social polity, the racial characteristics, the industries and occupations in relation to the fertility of the soil and natural deposits of mineral wealth, the influence of communications and transport and the effect of human contacts afford excellent and stimulating reading.

The regional geography of Asia which occupies the greater part of the book must in the nature of things follow the usual plan of geographical works, setting forth the details of provinces in their physical and ethnic features as well as their social, political, moral and material advancement. The second part is encyclopædic: and each

chapter bears the impress of a critical insight and scientific temper which distinguish Prof. Lyde's works.

A few errors, possibly through oversight, have crept in. In the chapter on "Natural Faunas" on page 163, the following sentence occurs:—"And if our description of the Tundra was sufficiently complete and pertinent, we may expect a more or less 'amphibious' fauna, even if true amphibians —like reptiles—are absent." If the word "like" in this sentence means "of the same kind" then the classification is clearly wrong. On page 468, in the description of the Cauvery Basin, we read, "Behind this, perhaps, is the solid fact that the river winds down from its Coorg heights (5,000 ft.) in densely forested ravines, and even in Mysore flows often in deep rocky glens, where evaporation and population are alike at a minimum. A good deal of water is taken from it in Mysore by a dozen anicuts specially by the famous 'Madadhatte Channel' which lights Mysore city and irrigates the 70 odd miles between that and Seringapatam." Obviously there is some confusion here. A few of the old anicuts have been submerged in the famous Krishna Rajendra Sagara Works and there is no such channel as "Madadhatte". If this is "Meke Dhat" then the power that lights Mysore does not come from this area, but from Sivasamudram and the river which debouches between two rocks at Kankanhalli, is unfit for irrigation purposes; the only channel which is 76 miles long but does not irrigate 70 miles of land is Chikka Devaraya Sagara Channel. Again on page 465, one of the peaks of the Nilgiris is called "Makrati" and the whole poetry attached to this romantic hill called "Mukarthi" is robbed by the license in spelling. Space forbids mention of a few other errors. None of these are of great account. In spite of these trifling blemishes. the book is a notable achievement of a great mind.

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THE METHOD AND THEORY OF ETHNOLOGY: An Essay in Criticism. By Paul Radin. (McGraw-Hill Book Company, Inc., New York and London. xiii+267 pp. 1933.) Price 15*s*. nett.

Within the last few years there have been several contributions on the method of Ethnology and this fact might seem to denote that this branch of knowledge has arrived at a stage when ethnologists are prepared to look back upon their past achievements with critical objectivity and to devise methods of investigation and correlation of data for the purpose of brigading Ethnology under the ranks of exact sciences. The power of deducing general conclusions capable of wide application is not the sole attribute of science and knowledge grows not so much by theories and hypotheses as by the accumulation of careful and correct observation of facts and their faithful documentation; the correlation of data under specific and related categories and the elimination of error, exaggeration and prejudice. Any systematised effort to gain new knowledge is as much entitled to be called research as the most elaborate experimental arrangement for investigation of physical problems. Most of the Biological sciences should devote greater attention to the collection of facts by trained observers endowed with the faculty of self-criticism, unhampered by discussions of methodology and theories. The study of racial culture of primitive tribes, their social organisation, customs, manners, religions, superstitions, beliefs and practices, offers a wide field for the play of personal temperament, special interests and prejudices of particular schools of thought; and in the eagerness to establish any preconceived theory, we are apt to miss the fundamental object of enquiry, *viz*., to obtain a complete and authoritative account of everything pertaining to aboriginal tribes. According to Paul Radin, we have to distinguish between the attitude and interpretation of the ethnologists and it not infrequently happens that what the ethnologist calls interpretation of aboriginal culture is really his attitude towards the study as is often evidenced by his mode of describing or discussing the subject. The book stresses the difference between these two modes of approach and points out its importance in the investigation of racial problems.

The aboriginal people may be studied from the standpoint that they occupy a lower scale in evolution and therefore, their organisation must be inferior to our own. According to this view, their customs, manners and culture must have phylogenetic significance and the culture of civilised nations must be so many offshoots, having their roots in the aboriginal races. Among those who hold the evolutionary concept of cultures may be mentioned Thurnwald, Durkheim, Rivers, Haddon and Radcliffe-Brown.

The attitude of Boas and his school is that nothing can be predicted of a given culture, but its specific character is first to be determined. No general conclusion can or should be drawn before a large number of cases are carefully investigated and their specific affinity is demonstrated. A classification of cultures into classes, families, genera and species on the basis of biological classification of living organisms, would come nearest to expressing the truth of Ethnological studies. This is the quantitative treatment of culture.

The third attitude which is really the attitude of the author represents that the study of racial cultures has the purpose of being a specific and comprehensive statement of the subject. The book is a scholarly exposition of this basic viewpoint. The data of Ethnology,—culture traits, culture areas and culture centres,—do not use themselves to be treated as those of biology or physics. It is true that most authors may not agree with this view.

The book purports to be an essay in criticism of the theory and method of Ethnology. It really represents a disinterested endeavour to examine and make known the best in Ethnological literature.

* * *

THE CAUSES OF WAR. By Sir Arthur Salter, Sir J. A. Thomson and others, with an Introduction by Ruth Crauston. Edited by Arthur Porritt. (MacMillan & Co., Ltd., St. Martin's Street, London. xv+231 pp. 1932.) Price *7s. 6d.*

The book is the outcome of the deliberations of one of the four International Commissions organised by the Executive Committee of the World Conference for Internal Peace through Religion and the members of the Commission whose contributions are embodied in the book are distinguished alike for their public service and peaceful temperament. The reports prepared by competent authorities on economic, industrial, commercial, racial, political and cultural causes which produce armed conflict between nations or groups of nations, are set forth in great detail and chapters dealing with the secondary contributions made by such agencies as Science and the Press make the book a self-contained unit.

The great merit of the book is that it has not the flavour of official reports, and is therefore eminently enjoyable. The information is full and authoritative. The arrangement of matter leaves little to be desired. Making allowance for individual differences, the style of presentation is masculine and crisp. The causes which lead to open hostilities are examined in a thoroughly critical and dispassionate spirit. After the book is read, the effect produced is peace-mindedness and so long as the effect lasts, you seem to belong to a different world.

Before 1914 when Europe was literally dying for war, any trivial cause might have —as it did—provoked a universal conflagration, but since 1919, Europe is unable to embark on the enterprises which between the years 1914—1918, seemed to engulf civilisation. However willing any nation may be to repeat and improve upon the atrocities of the Great War, the possibility is rendered remote by two factors, *viz.*, war debts and war weariness. Moreover while in the past history of mankind any single cause such as dynastic disputes, religious fanatism or homicidal mania of a despot, might have led to devastating wars, the present-day international relationship of civilised communities will take a great deal of provocation, preferring to expend it all in diplomatic despatches, to making it the basis of armed conflict. The cases in which Governments intervene refer to population problems and colonial establishments and economic policy including trade and industrial relationship and religion has practically ceased to be an active force in producing breach of international peace. The first two groups of causes or affronts may be summed up in one word "Imperialism" which under the pretext of protecting the superiority of one's culture and the purity of racial organisation, forming the root of national arrogance, must in its dynamic phase, involve violence and warfare. Imperialism is a recrudescence of the age-old theory of might, whether in the field of culture, politics or economics. The two fangs of imperialism are oppression and exploitation and the poison that flows through them is pride and aggrandisement: the power which stimulates the latter and causes the former to strike is "Civilisation".

By civilisation, we mean the external embellishments of life with all their deranged balance of wealth, unequal means of employment and lop-sidedness of society. Unlike beauty, civilisation is not even skin-deep. It has not touched the mind. The mind stuff has practically remained the same as when it first emerged from some remote age-like ancestor. A cultured mind is one

that has grown by accretion of knowledge, but is not one that has undergone any fundamental transformation either in essence or in structure. The humanising influence of religion and morality has not altered it as was evident on the fateful fields of Flanders in 1914 and all the churches in the World were unable to prevent the colossal struggle. The fact is that religion as symbolised by modern civilisation comes very much through the head of man but not directly from the heart. The fierce economic competition and the desire to possess all the wealth of the world exclusively have chloroformed religion and the theory that all is fair in Love and War has deadened allegiance to ethical principles.

Is it not a fact that in the background of the public mind of Europe, there is a wild confusion of cross currents of a medley of problems which prevent the nations from agreeing to any proposals of disarmament, economic reconstruction and promotion of general co-operation for the establishment of peace and harmony? Are we peace-minded? We can conceive of no human power the invocation of which will usher a new heaven on earth, except the determination of any one of the single major powers of Europe to disarm totally and absolutely. Every weapon of offence should be destroyed and the Bishop of London who in the course of the Debate on the motion of Lord Dawson's Bill for its second reading to restrict the sale of contraceptives, declared that he would like to make a bonfire of them and dance round it, might more fittingly have wished for a bonfire of all the engines of destruction and lead a merry dance of all the Bishops of Great Britain. We know that it is utterly futile to suggest total and absolute disarmament, and the exclusion of anything of human manufacture that will slaughter. But suppose Great Britain were to do it. What will be the effect of such disarmament on the World?

The book is an excellent contribution to the Science of Peace. It represents the wisdom of great minds and worthy of being universally read.

* * *

PAGAN SURVIVALS IN MOHAMMEDAN CIVILISATION. By Edward Westermarck. (Macmillan & Co., Ltd., St. Martin's Street, London. viii + 175 pp. 1933.) Price 8*s.* 6*d.* net.

All superstitions die hard and they are universally distributed. They generally arise in ignorance and fear and hold an unrestricted sway over primitive minds. Their influence in one form or another is evidenced even among highly cultivated societies. There is no religion but has a budget of superstitious faiths.

The book which collates the personal experiences of the author during his sojourn in Morocco is a notable addition to anthropological literature. These studies were first presented in the form of lectures at the University of London. The principal line of argument is devoted to establish the thesis that Islam received its quota of pagan beliefs and practices from the Arab communities amidst which it was born and as it spread in other countries and converted other races, it continued to absorb the alien superstitious faiths. The spread of religion is not unlike the course of a river which gathers the contamination of all the tracts of country through which it flows, while, however, the purity of the waters is to be found only in the mid-stream just in the same way as the cardinal and elevating doctrines of religion are to be met with in the heart of its teachings. The differences and disputes over the tenets of religious communities centre in the polluted parts of the marginal waters used for daily use and so much are the religious doctors accustomed to unwholesomeness that they forget the existence of life-giving waters of the central channel. The numerous affluents which swell the main current bring in a load of muddy superstition with the result that the imbibition of marginal waters becomes intoxicating and accounts for men slaughtering each other in the name of God who is full of peace and love.

The spread of science weakens the influence that superstitions exercise on men's mind and which religion unconsciously tends to promote. In any endeavour for the ascertainment of truth, superstition hampers progress and where truth is revealed without effort its propagation must necessarily rely on magic, myth, miracles, sacrifices and sacerdotalism. Where a fact or a phenomenon is not easily accounted for, religion explains as the work of elves, jinns and other supernatural agenices or the malign influences of evil eyes, spells and charms; but science attributes it to chance by which is meant that we do not know everyone of a very large number of independent facts influencing the result. The spirit of active enquiry promoted by science and the

spirit of passive acceptance enjoined by religion must necessarily make a wide difference in the training and outlook of mind.

Westermarck's exposition of this fundamental difference which distinguishes the primitive and enlightened minds is clear, logical and convincing. Many of the beliefs to which he refers are universal, for instance, the mischievous and malicious intentions of jinns in human affairs, their occurrence in diversified forms, the influence of evil eyes and the potency of curses and the remedies for them all, are common to every country and to every grade of civilisation and where they flourish ideas of propitiation in their multitudinous varieties must naturally spring up; and in course of time, become consolidated into institutions. Thus the establishment of a liaison with the mystic ceremonies of religion becomes easy and natural. It follows that, if there be any power to overcome the unholy influences of beings who live and work in the dark, that power must belong to righteousness and to beings who love light. Religion which relies in some measure on miracles, spells and other potencies for its propagation and does not discourage superstitious faiths and practices, also invents prophylactics and remedies for the malignant influences of evil spirits and men's evil desires. So long as ignorance and ritualistic practices prevail, superstition is bound to exist.

As we read the book, many of the things which are familiar to us from childhood, are brought back to our mind and strangely enough, that as ignorance is homogeneous in the world of mind, its products wherever they occur are identical, only, however, with such local colour as priestcraft might impart. The book is written with clearness and cogency which distinguish the works of Westermarck and is a faithful record of patient and prolonged study, entirely free from exaggeration and hasty inferences. The chief merit of the book is that it narrates universal facts with the precision of a scientific treatise setting forth the facts as they occur.

* * *

INTERNATIONAL ATLAS OF CLOUDS AND OF STATES OF THE SKY. Parts I and II and an abridged edition of Part I for the use of observers. (Published by the International Meteorological Committee, Paris Loffice National Meteorologique.)

It has long been realised that if a careful watch be kept of the sequence and evolution of clouds it provides us with valuable information for the forecasting of weather.

The first attempt at classification of clouds was made by Lamarck in 1802. As his nomenclature was French and as the paper appeared with much unscientific knowledge, the classification received no recognition. In striking contrast, when Luke Howard published next year in the *Philosophical Magazine* a cloud classification, it met with immediate success and has formed the basis of all future classifications. Three main types of clouds Cirrus, Cumulus and Stratus were recognised and all other cloud forms, especially Cirrocumulus and Cirrostratus, were supposed to be derived from the three. Later the genus Stratocumulus was introduced by Kaemtz in 1841. Renou in 1845 redefined Cirrocumulus and Cirrostratus in the way as used at present, and added with appropriate definitions the genera Altocumulus and Altostratus. He also pointed out that the cloud forms were characteristic of the heights where they occur. Poey introduced Fractocumulus and Mammatocumulus.

A great step forward was taken by Hildebrandsson when he applied photography for cloud study. In his book (1879) he reproduced 16 cloud photographs and also introduced the genus Nimbus for low dark clouds from which continuous rain or snow was falling. Hildebrandsson in conjunction with Abercromby published in 1887 a consolidated scheme based on Howard with the modifications from Kaemtz and Renou. Four levels whose mean heights were derived from measurements in Sweden, were assigned to clouds. Sufficient recognition was by this time forthcoming to lead the International Meteorological Conference held at Munich to appoint a sub-committee composed of Hildebrandsson, Riggenbach and Teisserane de Bort to produce an International Cloud Atlas based on Hildebrandsson and Abercromby's work. The committee had to face great financial difficulties and finally Teisserane de Bort published the Atlas under his sole responsibility in 1896. This work contained 27 coloured plates with text in French, German and English.

Though the 1896 Atlas systematised to a great extent the knowledge about cloud forms, practical difficulties arose later; new sub-forms had to be introduced, and all countries did not adopt uniform cloud definitions. Also the advance in the knowledge of meteorology and the development of

aviation necessitated a thorough revision of the Atlas. In 1921 Sir Napier Shaw as President of the Committee asked for suggestions on cloud study and his successor wished to embody the suggestions in a new cloud Atlas. A cloud committee with Gen. Delcambre was brought into existence and the scheme put forward by the Committee was approved in 1929 at the Copenhagen meeting of the International Meteorological Conference. It was decided to publish a General Atlas of clouds and states of the sky called Part I, an abridged edition of Part I for the use of observers, and Parts II and III to be devoted to clouds in the tropics and special local clouds. The last two parts were entrusted to Drs. Braak and Bergeron respectively.

The munificence of a Spanish philanthropist M. Rafel Patxot made it possible to publish and place on sale the general cloud atlas and its abridged edition at a very low price. The abridged edition was ready in 1930 in time to meet the needs of the introduction of new meteorological codes formulated at Copenhagen. The General Atlas and the one dealing with tropical clouds have subsequently appeared (1933).

Among the major changes that have been introduced it may be mentioned: the definition of cirrocumulus is restricted to clouds forming part of or evolving from other cirriform clouds; clear distinction is drawn between altocumulus and stratocumulus in that the smallest of the well-defined regularly arranged elements in altocumulus should not be greater than ten times the sun's diameter; and cumulonimbus should have a cirriform top. Instead of the term Nimbus used differently in different countries the genus *Nimbostratus*, formed by the lowering and thickening of an altostratus cloud from which continuous rain or snow may be falling has been substituted.

To give precision to the cloud forms observed from an aeroplane from above a special chapter has been written and has been illustrated by several plates. Another chapter is devoted to the "States of the Sky" giving the progression of cloud forms in a typical depression of the temperate regions.

The get-up and reproduction of the plates deserve great praise and would draw approbation from any artist.

The abridged edition contains 41 out of the 174 plates and the text portion confines itself mostly to the sections needed for a surface observer.

Part II dealing with clouds in the tropics has been undertaken singly by Dr. C. Braak, a former Director of the Batavia Observatory. Most of the original photographs were taken in Dutch East Indies. It is apparent from the text that a comparatively small belt within the neighbourhood of the equator is under consideration. Great stress has properly been laid on the diurnal variation of clouding due to insolation and on the local formations which contrast with the cloud sequence met with in depressions of temperate latitudes. According to Dr. Braak the regular sequence of clouds associated with typical depressions in temperate latitudes does not occur in connection with disturbances in the tropics, but the cloud forms met with are nearly the same in both the regions. While the depressions and cyclones are not as frequent in the whole tropical zone as in the temperate zones, it may not be quite accurate to describe them as rare. Nearly a dozen depressions or cyclones occur in the Bay of Bengal and the Arabian Sea during a year and the greater part of them are formed from May to December. The cloud forms Altostratus and Nimbostratus may become rarer as we approach the equator but they do occasionally occur associated with depressions in tropical India. The decrease in visibility towards the end of dry season would perhaps be of practical importance to aviators. While one may differ in a few places from the opinions of Dr. Braak, one must cordially admit that he has brought together most of the peculiarities of the tropical regions and has shown that similar meteorological phenomena may be accompanied by very different results in the tropical and temperate regions. This by itself would justify the production of part II, which in addition contains a few interesting photographs showing the influence of mountains on clouds.

The reproductions of cloud forms in the tropical atlas cannot be said to have attained the same very high mark as in the General Atlas. But the reason may not be far to seek, because the number of photographs from which choice had to be made was small.

It would be well worth while to collect and publish a similar series of photographs taken in India when circumstances permit it.

S. L. M.

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A TEXT-BOOK OF APPLIED HYDRAULICS. By Herbert Addison. (Chapman & Hall, Ltd., London.) 21*s*. nett.

The author of this volume has succeeded in presenting in a clear and simple style, a comprehensive yet concise summary of the fundamental principles of hydraulics, striking an even balance between theory and practice. The book covers a large field doing justice to every phase.

The aim of the author that the volume should serve as a Text-book for students working for an engineering degree and also as a work of reference for engineers in general is ably achieved. Its theoretical treatment mostly confined to the first part of the book is very suitable for engineering students and the comprehensive and practical character of the second part justifies its recommendation to all engineers who may be interested in or need information concerning present-day hydraulic practice.

The subject-matter ranges from simple principles of hydraulics to a study of pipe systems, control of water in open channels, pumping machinery, hydraulic transmission and performance and construction of hydraulic turbines. A noteworthy and desirable feature of the book is the inclusion of results of experiments of scale models for studying hydraulic problems. There has been a steadily growing confidence placed on the reliability of the indications from laboratory tests of small-scale models leading to efficient designs of large water structures, such as dams, sluiceways, turbines, centrifugal pumps and propeller pumps. A considerable amount of new material made available by recent researches in backwater and standing wave phenomena is also included. Results of experiments are wherever practicable presented in a graphical form which brings home to the student with definiteness and clarity the underlying principles. The use side by side of both Imperial and Metric Units is advantageous to readers used to either system of units: for instance those accustomed to the Imperial Units can readily follow continental technical literature and *vice versa*.

On the whole the book is very well written and must have involved a large amount of labour. The exposition is clear, undoubtedly as a result of the author's several years' experience as a teacher. Needs of the students are met by the worked out examples at the end of the book. In future editions of the book more graded examples for practice might be added at the end of each chapter instead of a single series at the end of the book. Text-books generally tell so little about the principles of hydaulic similitude and principles of dimensional analysis. As in the book under review results from model experiments are copiously quoted, it will be of great value if a chapter be added in future editions treating of the methods of dimensional analysis and their applications as well as the principle of similitude, which have to be thoroughly understood in order to apply the results of experiments on models to structures of large size.

The publisher's work as well as that of the author has been well done. The diagrams are numerous, well drawn and the several photographs representative of modern plant and of the scale models are well chosen and these will greatly assist the student in his comprehension of the text.

The book will serve as a suitable text for engineering students and will be a welcome addition to the reference library of an Engineer.

V. G.

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THE DESIGN AND CONSTRUCTION OF HIGH PRESSURE CHEMICAL PLANT. By Harold Tongue, A.M.I.Mech.E., A.M.I.Chem.E. (Published by Chapman & Hall.) 30*s*. net.

Chemical Engineering is rapidly developing but there are very few books dealing with the Engineering side of the Chemical Industries. The author has spared no pains to collect information and present them in a useful form. In the second chapter he has dealt with high pressure gas compressors. The books on compressors do not generally deal with such high pressure compressors and the author has described only plant manufactured by leading firms in England and Germany to show the trend in the design of such plants, but there are very good plants manufactured in France and Italy. The book would have been more valuable from the point of designers of Chemical plants, if the approximate cost of the plants were given just as they are given in some books dealing with the design of Power-Plants.

In Chapter IV the author deals exhaustively with the design and maintenance of pressure vessels, the only shortcoming being that the kind of paints, etc., that have got to be used to prevent the formation of rust, etc., in the vessels during service and

the method of applying the same has not been dealt with as exhaustively as the rest of the subject. Only a passing reference is made to the scheme recommended by the British Engineering Standards Association, whereas, a large amount of extracts of recent English patents are given at the end of the several chapters.

The subject of autoclaves and the design of pipings, valves, etc., are fully dealt with and also neat drawings of several designs are included. In fact the book is profusely illustrated with neat drawings and photos. In Chapter X, he deals with the construction and manufacture of pressure vessels, and an idea of manufacture of the plant is necessary for the preparation of correct designs, and the author has done well to include a chapter on this subject.

On the whole the book is well written and well illustrated and the author deserves to be congratulated on the production of such a useful book for designers of chemical plants.

E. K. R.

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SOIL ANALYSIS: A Handbook of Physical and Chemical Methods. By C. H. Wright, M.A., F.I.C. (London: Thomas Murby & Co., 1934. vi + 236 pp.) Price 12*s*. 6*d*. net.

There are a few publications such as those of the A. O. A. C. or the Chemists' Year Book which describe many of the better known methods of soil analysis. Some useful particulars are also given in appendices to monographs like those of Russell. The information thus provided is not, however, quite complete and each laboratory is obliged to work out its own methods to suit the local conditions and available equipment. As may be naturally expected, such improvised methods do not share the same degree of accuracy, so there has always been considerable difficulty in comparing results obtained from different laboratories. The present publication which deals with the different routine methods of analysis is, therefore, a welcome contribution, especially to those working in out-stations, far away from the bigger libraries.

The book has presumably been intended to cater to the needs of those who have already had some useful training in soil analysis but wish to have some book of reference for the relevant details. To such workers, as also to those who, though having access to original literature, wish to have only a few details such as strength of reagents or order of treatments, the book will come in very handy. It will also be found useful by those who wish to make a general survey of soil methods. It is rather doubtful, however, if students who are just being initiated into the subject will find it an easy book to follow.

The occasional foot-notes provided by the author supplying further information or offering certain comments based on personal experience are quite useful and one wishes there were many more such notes presenting critical analyses of the different methods. In fact, such comments should form a regular part of the book and follow the description of each method cited in the text. Absence of such details leaves a worker, unused to a particular type of technique, quite at sea, especially when a number of methods are cited. The meagreness of illustrations would be found a handicap by those who wish to set up new apparatuses for work. The omission of theoretical principles would also be felt by many workers who would naturally wish to understand the significance of each step involved in an estimation. Many of the proposed items of procedure may be obscure or unnecessary and an analyst with an original outlook may like to simplify or otherwise improve on them without sacrificing accuracy. The absence of theoretical background would discourage such efforts. It is hoped that the above suggestions would receive the consideration of the author when the text is being prepared for the second edition. The discerning reader will not grudge any extra price that may be levied for the additional matter.

The efforts of the publishers and printers in the preparation of the book deserve much praise. The paper used is of high quality and the printing very neat. The binding is also quite elegant. Considering the quality of the matter and the get-up, the price is not too high.

V. S.

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PFLANZENCHEMIE UND PFLANZENVERWANDTSCHAFT. By Dr. Hans Molisch. (Gustav Fischer, Jena, 1933.)

Dr. Hans Molisch, Professor and Director of Plant Physiological Institute in the University of Wien, has brought out an attractive volume on Plant Chemistry and Plant relationships which aims at showing the importance of plant chemistry in understanding the relationships of plants with one another. Just as the knowledge of

external and internal morphology is indispensable for the systematic classification of plants so also is the knowledge of Phytochemistry helpful towards the same end. He has shown the connection between chemistry and plant affinities by pointing out the presence of specific substances in the same race, in the different races of the same genus, in different genera of the same family and in more or less related families. He has supported his views by taking evidence from the chemical differences between male and female plants like the positive and negative strains of Mucorales, from the transplantation experiments and the various reactions by the application of serological methods.

According to the author the chemical substances present in the cells and the various reactions they set up, influence the shape and form of the tissues and organs of the whole plant. It is now felt that the genes which determine the morphological characters of organisms are also responsible for biochemical differences between them and consequently all the differences that distinguish one species from another can be traced to the differences in the genes.

F. F. Blackman (1921) in a thought-provoking contribution tried to show that the chemistry of carbohydrate production in plants can be used for the biochemical classification of plants and for deciding their systematic relationships. This important contribution unfortunately is not mentioned by the author as it certainly, in a way, supports the author's conclusions. It is true that the biochemical differences and resemblances may help us in deciding plant relationships in some cases the present state of our knowledge of the chemistry of the cells and diversity and complexity of the chemical reactions occurring in it should make us extremely cautious in making it our guide, in studying natural relationships. The book is extremely well written and will be a useful guide to those who are interested in plant chemistry.

R. H. D.

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QUALITATIVE CHEMICAL ANALYSIS. By Roy K. McAlpine and Byron A. Soule. (Chapman & Hall, Ltd., London, 1933. xii+696 pp.) Price 21*s*.

The student of chemistry interested in qualitative analysis looks for at least two principal features in any text-book: (i) a sound theoretical treatment of the principles underlying analysis, and (2) the arrangement of the material in an accessible way for reference, the analytical procedure being described with reasonable fullness. The present publication satisfies these two requirements to a generous degree.

Text-books on qualitative analysis are by no means rare; but only a few of them are popular. One such is that by A. B. Prescott and O. C. Johnson, published nearly two decades ago, and to-day out of date. The present publication while retaining the merits of a book which had stood the test of time has been considerably enlarged so as to incorporate the more recent developments in this branch of chemistry and improved so as to emphasise and, or, elaborate these aspects which the users of the classical text-book demanded. Analytical chemistry is no more to be looked upon as an art which needs to be perfected by practice; it has emerged out as a science based on well-established laws governing reversible reactions and ionization, and an adequate treatment of the theory is to-day a necessity for an intelligent understanding of the procedure which the chemist practises in the laboratory. It may be said, without hesitation, that the neglect of the theoretical background has been mainly responsible for rendering qualitative analysis a bug-bear to the University student. The authors have sought to remedy this defect, and the first 150 pages of the book are devoted to a lucid exposition of the principles an understanding of which will provide the master key for unlocking the complexities of the procedures described in the succeeding 400 pages.

The book contains much more matter than is envisaged by the title. Details pertaining to preparation and properties of elements ordinarily treated in text-books of inorganic chemistry, are given. This is perhaps superfluous in a book on qualitative analysis. The description of physical properties such as solubility of important salts and reactions of the elements are, however, relevant. Copious references to literature are provided, a feature of obvious importance to the progressive chemist, and a very useful appendix including among others, tables of solubilities, reduction potentials and atomic weights, gives a fair amount of supplementary information. The more usual tabular statements concerning the detection and characterisation of the individuals of the different analytical groups, will be found

invaluable for reference during laboratory work.

The procedures described have been tested out and the student is advised to use 15 c.c. of solution containing 20 to 100 mg. of substance for his tests. While more concentrated solutions can be diluted to conform to the specifications and the procedure followed, very often the usual method will be found to be untenable when only minute quantities of substances are available. Recourse must be had to more sensitive tests. A chapter on micro methods would have greatly added to the value of the work. These methods which are of comparatively recent development are extremely sensitive, often specific and allow of rapid examination; great advances have been achieved in the use of organic reagents, forming co-ordinate compounds with metals which are more or less stable and often either highly coloured or sparingly soluble. It appears most desirable that the University student should be initiated into the methods of microchemistry early in his career and an adequate treatment of this aspect of analytical chemistry should be included in any text-book. We hope that this omission would be remedied in the next edition.

We welcome this excellent work embodying "principles and methods used in identifying inorganic substances together with a systematic survey of the chemistry of these substances" and recommend it to the University student, who will find it useful not only during his College course, but also later in his career as a chemist. It deserves a place in every reference library.

N. S.

* * *

FLUORESCENCE ANALYSIS IN ULTRAVIOLET LIGHT. By J. A. Radley and J. Grant. xi+219 pp. (Chapman & Hall, London, 1933.)

For the success of the chemist whose activities cover a very wide range of subjects—from forensic medicine to agriculture—what is perhaps most essential to-day, is a bold departure from the traditional methods of analysis and synthesis and an attempt to invoke the aid of new technique for his investigations. This is particularly true in the field of Applied Chemistry where by employing new tools for his work, the Chemist either succeeds in throwing fresh light on many complex problems or in independently confirming the results indicated by other methods.

The book under review is an attempt to bring between the covers of a handy volume a very large number of stray observations concerning the use of fluorescence methods for analytical purposes. The publication brings home to the chemist the most modern developments in the subject and constitutes an eloquent appeal for a more intensive and extensive research on the application of fluorescence methods to specific problems.

The Second Part of the Volume dealing with the applications contains 19 chapters. The theory and technique has been adequately dealt with in the first 55 pages and any one who takes to the subject anew will find from the descriptions the necessary practical details. He will also be able to know the pitfalls he has to avoid in the application of the technique. The subject-matter in the second part takes the form of a catalogue of observations by various workers. Perhaps this is inevitable while dealing with a subject comparatively recent and a large number of workers have applied the methods to a variety of problems without an adequate investigation of the theoretical aspects. Many of the results achieved are only of a qualitative nature, but obviously the subject is still in its infancy and has yet to grow. We are surprised to find in the book no more than a mere mention of "Fluorometry", a new method of micro analysis which should prove exceedingly useful in the estimation of substances which are either fluorescent themselves or become so after addition of suitable reagents, but which do not lend themselves to determination by either Colorimetry or Nephelometry.

The book is perhaps the first of its kind in the English language and should command the appreciation of a large number of chemists, who will find in its pages the description and application of a new tool which may be used with profit for the solution of their own specific problems.

N. S.

* * *

ORGANIC SYNTHESES. Vol. XIV. Edit by W. W. Hartman. (Chapman & Hall, Ltd., London, 1934.) Price 10*s.* 6*d.*

Organic Syntheses is an annual publication of complete detailed directions for the preparation of some organic chemicals taken at random. The first of the series of which the present one is the 14th member, appeared in 1921. In the year 1932 a collective volume

incorporating all the preparations described in the previous nine individual volumes was published wherein various indices, *e.g.*, Reaction index, compound index and formula index, going a long way to help the worker in finding out the right thing he wants, had been introduced. The publication of these pamphlets will act as a boon, though in a restricted sense, to the organic researchers. If fortunately, the preparation one wants happens to be described in any of these publications, he is immediately in possession of the very best authoritative method and is thus saved the trouble of experimentation to find out the exact conditions necessary for securing a good yield of the desired product. While realising the stupendous and apparently unending nature of this task, it has to be remarked that the number of preparations described annually are infinitesimally small to cope with the need of the workers.

The classification of the details of each preparation into three sections, namely, (1) Procedure, (2) Notes, and (3) Other Methods of Preparation, is commendable indeed. But in the section 'Procedure' the insertion of too many minor details sometimes approaches very nearly to unnecessary repetition and spoon-feeding which might stand in the way of proper development of imaginative and creative faculty of the researchers. The second section 'Notes' is really a very useful portion as it strikes a note of warning about the pit-falls in the preparation. Section 3, *i.e.*, Methods of Preparation, though not an exhaustive review of the literature, gives in brief the other alternative methods being particularly useful for those to whom Beilstein and other reference books are inaccessible.

Talking about the present volume, the printing and get-up are as excellent as in the previous ones. In view of the expected collective volumes to appear periodically, such an elaborate get-up is perhaps unnecessary. It is not necessary to be so lavish with the pages as in the present and also in most of the preceding volumes. Out of the pages describing 26 preparations, more than 22 pages are left untarnished by printer's ink. Again, the structural formulæ always take up space and in a practical book of this nature their number may be lessened. On page 30 of the volume under review three formulæ are written twice each, which repetition could have been avoided by insertion of arrow-heads only. The price of the book which is so high as 10*sh.* 6*d.* net could perhaps be brought down by paying a little more heed to these points.

There is no one particular system followed in selecting the preparations. They have been gathered at random, collected together in a volume and printed. Such a haphazard mode of collection is open to the possibility of missing important and commonly needed preparations. It may be suggested, therefore, if instead of this present procedure, a systematic undertaking of a set series of preparations representing various types of reactions is programmed, as is done in Houben-Weyl's book, one can at least visualise the limit of the work, even which may not be near. Such a systematic undertaking of preparations will be of greater help to the researchers than at present.

On the whole, the series of publications is of great help and can whole-heartedly be recommended for use to the advanced organic researchers.

P. C. GUHA.

* * *

THE FLATFISHES OR HETEROSOMATA: A Systematic Monograph of the Flatfishes (Heterosomata). Vol. I. Psettodidæ, Bothidæ, Pleuronectidæ. Pp. viii+459, figs. 317. By J. R. Norman. (Printed by order of the Trustees of the British Museum, London, 1934.)

The Flatfishes or Heterosomata are characterised by their greatly compressed body and by their remarkable departure in general symmetry from the usual bilateral shape characteristic of the majority of vertebrate animals. To an average zoologist, they are known as fishes with both the eyes on the same side of the head. The evolutionary steps by which this asymmetry "has been brought about in the natural history of the group, and the ontogenetic modifications by which it is brought about in the history of the individual, have been extensively discussed and described without the interest of the facts having been exhausted, and possibly without all the facts themselves having been brought to light". In recent years considerable attention has been paid to the ecology, bionomics, evolution and anatomy of these fishes, but the starting point for all these investigations has to be an accurate knowledge of the systematics of the group. This was supplied by Günther in 1862 in the fourth volume of his *Catalogue of Fishes in the British Museum*, but since

then no attempt has been made at a comprehensive systematic revision of the Heterosomata, which includes some of the most important and valuable food-fishes in various parts of the world. In India, however, we are ignorant of the economic importance of these members of the finny tribe, because our fishery resources are not at all developed and full advantage is not taken of the vast wealth of the sea. Moreover, the methods employed for fishing in this country are not suitable for the capture of the Flatfishes which live at the bottom and rarely swim about.

It is a matter of great satisfaction that the Natural History Section of the British Museum has once again supplied the great need by undertaking the publication of "A Systematic Monograph of the Flatfishes (Heterosomata)" the first volume of which has already made its appearance and deals with three out of five recognised families of the group—the Psettodidæ, Bothidæ and Pleuronectidæ. The remaining two families—the Soleidæ and Cynoglossidæ—it is promised, will be dealt with in another volume. Mr. J. R. Norman, Assistant Keeper in the Department of Zoology and the author of the work, is well known among ichthyologists for his brilliant researches on fishes. For some time he has been devoting considerable attention to the study of the Heterosomata of different parts of the world, no doubt as preparatory to the most admirable work he has now produced. What is especially noteworthy about this work is that the author has not ignored the needs of a general Zoologist, and though the work is primarily meant for specialists, advanced students will also find it a mine of information on all topics connected with the Flatfishes.

The volume under review is divided into two parts, the General and the Systematic. In the former such topics as Origin and Systematic Position of the Heterosomata, Fossil Heterosomata, Evolution of Asymmetry within the Order, Albinism, Ambicolouration and Reversal, Development, Sexual Differences, Classification and Geographical Distribution are dealt with. Abbreviations and a list of papers are given and notes are included on measurements and bibliographical method. In the Systematic Part 82 genera and 300 species are treated and it is remarkable that of 300 species only 24 have had to be included solely on the evidence of the published descriptions whereas all the other species were either studied by the author or examined by Colonel Tenison. There are 317 text-figures and practically every species is illustrated. The figures are simple and neat, and they show very clearly the salient features of the fish they are meant to portray. For the figures we are indebted to Lieut.-Colonel W. P. C. Tenison. The volume contains a useful and comprehensive index.

The work is admirably written and well got up; it will be of the greatest service to all desiring the latest information about the Flatfishes. We must congratulate the author on his performance and the Trustees of the British Museum for having published the Monograph.

S. L. HORA.

* * *

TEXT-BOOK OF GENERAL ZOOLOGY. By Winterton, C. Curtis and Mary J. Guthrie with the collaboration of Katherine R. Jeffers. Second Edition. (John Wiley & Sons, New York, Inc. Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London. xv+554 pp. 1933.) Price 23*s*. nett.

The study of Zoology in the Schools and Colleges is undergoing a refreshing change and any departure from the study of types detached from one another, with no more interest than a detailed account of their anatomy, systematic position and developmental history can confer, must be welcome. This book expounds the principles of general Zoology from a new standpoint and is an extremely well-written book at that. The study of animals from a biological standpoint but not chiefly as representatives of phyla, is far more profitable as an educational course than the method usually adopted by the old books now in common use in the Indian Schools and Colleges. Even a comparative study of structural details, however valuable as a means of obtaining a comprehensive knowledge of the physical characters, is not free from defects. The value of any department of knowledge lies in its capacity to make the mind alert and inquisitive and after reading this book, we conclude that it possesses this quality in an eminent degree. In the American Schools, the Project Method is influencing the teaching of science and this idea coupled with the "Humanistic aspects" of the subject is the basis of the book. Most of the manuals and text-books of Zoology commence with the unknown, and this method must largely account for the sterile effect

produced by the teachers. The proper approach to Zoology is through a study of the vertebrate organisation and functions, with ecological references so that facts and phenomena familiar to the student may be used as the ground-work for building up advanced interests.

. The first few chapters are devoted to a review of the natural history, the anatomy, physiology and the development of vertebrates, followed by a clear and adequate account of general scientific principles and classification. The systematic portion of the various phyla has taken up eight chapters; this part of the book is not calculated to impress upon the mind of the learner the enormous richness and variety of the material comprising the province of his study. The final chapter dealing with the history of organisms is a clear exposition of the theory of Organic Evolution. The book is beautifully illustrated. There is an excellent glossary.

There are a few mis-statements; the following is one among them: "With few exceptions, the amphibia are confined to water and its immediate vicinity, or to a moist atmosphere. It is this characteristic that has given to these vertebrates the name amphibian which means 'leading two lives'" (p. 13). In a popular sense this description is true: but if it is not corrected by the scientific significance of the term "Amphibia", the impression created would be totally wrong. An amphibian is an animal which at one time or other of its life history possesses a circulatory system adapted both for aquatic and terrestrial existence; and this idea ought to be brought home to the mind of the students from the commencement of zoological studies. Fig. 22 on page 34 needs considerable improvement. The liver of the frog is not connected with the heart; its relation together with the pancreas, to the intestine must be properly indicated; the reproductive organ which is obviously an ovary, as the oviduct is shown, is surely not connected with the kidney and its shape is exactly like that of testis. The glottis is shown as a structure discrete from the pharynx. On page 298, under Anthoxoa, occurs the following sentence:—"These corals are like small sea-anemones to which a skeleton of carbonate of lime has been added as a secretion from the ectoderm." The sentence ought to begin thus, "These coral polyps are like, etc." On page 407, is given the description of the "deep nervous system" of the star fish and its position, *viz.*, "beneath the ventral epidermis" is clearly wrong. Its relationship to the haemal system is not indicated.

These are, however, a few errors which must inevitably occur and they are easily corrected. They do not detract from the general merit of the book. It has a great educational power and value.

* * *

THE PROGRESS OF MAN. By A. M. Hocart. (Methuen & Co., Ltd., London, pp. xvi+296, 1933). Price 7*s.* 6*d.* net.

This interesting book is a solid contribution to anthropological science and its purpose, *viz.*, a survey of the evolution of man and his works, in its bearings on physical anthropology, comparative psychology and cultural history of the human race, is admirably fulfilled. The domain of Anthropology is not only savages and curious peoples, but also civilised men; whatever is connected with human beings acquires a value and significance only when viewed from its evolutionary standpoint. It is true that the anthropologists are divided on the question of the treatment of their subject; and the voluminous data collected by patient and prolonged researches must possess little practical importance if treated as isolated studies of processes and phenomena: on the other hand they become intelligible when considered as part of the working of mind which though essentially simple, reacts diversely to the amazingly complex influences of the environment to which it is subjected. It is the power and richness of human mind and body in their manifold adaptive modifications, which offer the basis of all anthropological investigations; and their results acquire the validity of science in so far as they yield general principles capable of application to related groups of facts. The book deals with the facts of anthropological studies as one connected whole and its merit is that the seemingly diversified topics of human science are brought under a few basic formulæ.

In the chapter on Clothing, we read that "hairless man was evolved in a mild or warm climate where clothes are not needed for warmth", but could it be suggested that in Arctic climate, man still retains his primitive natural investment of hair? Rather we are disposed to think that whatever may be the influence of climatic

conditions, hairlessness of the body is probably the result of sexual selection. It is difficult to determine whether "clothes" were invented for purposes of protecting the body, or covering modesty or alluring by concealment, and perhaps more than one theory will have to be invoked for providing a satisfactory explanation. Modern picture films and suggestive bathing costumes lend support to the view that clothing produces shame.

On page 134, Buddhism is spoken of as a religion recognising Gods; rather its cardinal doctrine is "Nirvana" or "Nihilism"; right thinking and correct living are their own reward and are not the means of acquiring eternal bliss in Heaven. Nevertheless the chapters on "The Quest of Life", "The Sacraments" are extremely interesting.

On page 204, we read that "in India the idea of a soul is vague". We wonder if there is a single system of religious philosophy other than the "Upanishads", which offers a more complete, consistent and satisfactory theory of "soul", and these works have formed the basis on which the most magnificent systems of metaphysics have been reared and they still continue to inspire all philosophical thinkers. In a sense "soul" must remain an elusive subject and notions of it must be even vague, for unless a thing can be seen, handled and measured, its knowledge can be neither real, clear nor precise.

Again on page 282, discussing the relationship of Hamito-Semitic and Aryan languages, the author gives some curious translations of expressions selected from the inflected Dravidian and the agglutinative languages and the rendering is clearly wrong. For "the stick falls" Tamil says—"stick fall it"; for "in the house", "house place". The Tamils are ignorant of such expressions.

"The games of children merely reflect the culture of their elders" is a theory of play which will not be readily or universally accepted. There is hardly any game without two contending parties and the object of the engagement is victory or the assertion of the superior prowess of one over the other. The games of children may be rehearsals of the hunting instincts of their ancestors, *e.g.*, "Hide and seek" or an expression of the primitive longings of man to over-power the weaker members, which education, example and public opinion conjointly labour to humanise.

The last chapter about "Whither" is the shortest, but by far the most suggestive.

The blemishes that we have noticed are purely of a minor character, but do not detract from the general excellence of the book which every anthropologist will, we are confident, welcome as a successful attempt at synthesising the most salient facts which have been accumulating perhaps since 1881.

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